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WESTERN AUSTRALIA.

DEPARTMENT OF MINES.

REPORT

ON THE

NORTHAMPTON MINERAL FIELD.

BY

A. MONTGOMERY, M.A., F.G.S.
STATE MINING ENGINEER.

Issued under the authority of the Hon. H. Gregory, M.L.A., Minister for Mines.

PERTH, 3RD MARCH, 1908.

PERTH:
MORNING HERALD JOB PRINTING DEPT., JAMES ST.
1908.

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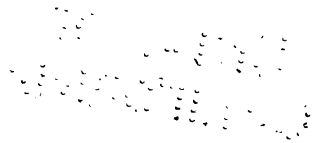

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REPORT

ON

THE NORTHAMPTON MINERAL FIELD.

Office of the State Mining Engineer,

Perth, March 3rd, 1908.

The Secretary for Mines, Perth.

I have the honor to inform you that in accordance with instructions I made a short visit to the Northampton mineral field on January 22nd to January 27th, and have now to report the results of my inquiries into the present position and prospects of mining therein. During my visit I had the pleasure of being accompanied by the Warden of the field, Mr. W. A. G. Walter.

As is well known, the Northampton district has been in the past an important mining field, but of late years has been all but deserted. There are very few mines now at work out of the large number that have been opened at one time and another, and the mineral output for a good many years past has been practically negligible. It was with the purpose of seeing if anything could be done to resuscitate the mining industry of this district that my visit was made.

Most of the mines are quite inaccessible, the shafts and workings having fallen in or become filled with water. Very little is to be seen on surface, and we have to depend upon past records mostly for information. Most of the available facts have already been published in official publications, and it does not seem possible now to obtain any further information of consequence, except perhaps by search for the papers of the various long-defunct companies which worked the mines, some of whose records and plans may have escaped from time to time have been published. It seems hardly likely that the benefits to be gained by such search would be worth the large expenditure it would involve.

The "Mining Handbook of Western Australia, by Mr. H. P. Woodward, F.G.S., etc., then Government Geologist of the colony, published (second edition) in 1895, gives (pp. 117-126) one of the fullest accounts of the Northampton mines and speaks very favorably of the number, size, and value of the lodes of lead and copper, quoting numerous figures to show that there were many rich and large bodies of lead and copper ores extracted. The next important official publication was Bulletin No. 9 of the Geological Survey of Western Australia, in 1903, containing a report on the district by the Government Geologist, Mr. A. Gibb Maitland, illustrated with an excellent geological map of the more immediate neighborhood of Northampton, and having appendices containing further reports on the district by Messrs. H. P. Woodward (dated May 30, 1901), and John Provis (dated June 17, 1903), records of borings made with a diamond drill in 1901 at Wheal Margaret, Northampton, and 'Old Cow Rock,' Narra Tarra, and a table of assays of lead and copper ores from the Northampton mining district made in the Geological Survey Laboratory. In this bulletin Mr. Woodward's description of the various mines is especially a very cate-

and 29 for lead, while 22 were on freehold property and 23 upon Crown lands. In Geological Survey Bulletin. No. 30, on the 'Distribution and Occurrence of the Baser Metals in Western Australia (1907), Messrs. E. S. Simpson and C. G. Gibson have again summarised all the information available as to the old mines. These publications leave very little to be said by any subsequent writer that is not mere repetition, and in the present report I have not thought it necessary to go over the same ground again, but would refer to the already published reports, confining my description to the few mines that were visited by myself. These were such as have been either recently worked or have lately been proposed to be worked. There was no use in visiting the others on which nothing could be seen. I append also, however, a recent report of Mr. S. Cullingworth, inspector of mines, dated September 11, 1907, as it contains some information not elsewhere included.

The Northampton field is not by any means a small one. Mr. Woodward considers it to extend from the Irwin River to north of the Murchison River, a length of some 110 miles, and that the width of the mineral belt is up to 30 miles. The district is somewhat hilly in many parts, and the tops of the hills are often composed of sandstone and grits, of more recent age than the mineral-bearing lodes. The latter are in old crystalline rocks of great antiquity. granite, gneiss, and mica-schist, traversed by a younger—though still probably very ancient—series of remarkable diabase dykes. These are well shown on the geological map, running in long lines, up to 10 miles in length, across the country in a roughly parallel series, with general north-north-easterly strike. Mr. Maitland's report points out that there is, however, throughout the district a general north-westerly strike in certain sheeted zones of schist and gneiss, which are not uncommon. This lamination of the country at a high angle to the dykes and the lodes accompanying them, whatever may be its origin, is not unlikely to have a traceable connection with the occurrence of shoots of ore in the lodes, and therefore deserves attention from future mine operators, though, as far as I am aware, it has not yet been noted as having any influence on ore deposition.

The lodes of lead and copper ores which constitute the mineral deposits of the district run generally nearly parallel to the igneous dykes, and are pretty certainly closely connected with these, even when no dyke is visible in the immediate vicinity. In one instance, at the Kingdom Come mine at Mary Springs, the dyke itself is in places much altered to lode matter and charged with metallic sulphides, and probably this feature will be found to be not infrequent. The occurrence reminds one strongly of that of copper ores in some of the dykes traversing granite country in the Phillips River goldfield. It is very evident that in prospecting the Northampton district for metalliferous lodes special attention should be directed to the edges of the dykes, and to the country alongside them. Several of the lodes, however, including some of the more important ones, as shown by the geological plan, are not seen to be immediately in the vicinity of dykes or connected directly with them.

In the following notes on the few mines visited by myself, they are taken in oorder from the north coming southwards:—

Kingdom Come, M.L. 112.—This lease is situated 4½ miles north of the Murchison River, and was formerly known as the Mary Springs mine. It was worked by the owners of the Geraldine mine for some five or more years before 1878, and has lately been taken up by Messrs. Archibald and Spear, who have received Government assistance to the amount of £200 under the Mining Development Act 1902 in purchasing and erecting machinery upon it, consisting of a boiler, winch, and steam pump, with a small set of poppet heads. At the time of my visit work was in progress unwatering the old water shaft, which was then proposed to be deepened to enable the lode to be cut below the old workings. There are three parallel lodes shown by the workings, the outside ones being about 160ft. apart, and, as above mentioned, the body of the igneous dyke in which they occur is itself at times so much charged with lead sulphides as to become lode matter from a mining point of view. The old workings must have been fairly extensive, but are believed to be quite shallow, probably not more than 50ft. deep. The old shaft on which the machinery has been placed is supposed to be down to 100ft. and perhaps to 140ft., and has been cleaned out and timbered to 45ft. by the present owners They may, however, transfer their plant to the old main shaft if, when they drive

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to it, it is found in good order below the fallen-in surface part.

In an open cut near the old main shaft a shallow crosscut has been driven for about 20ft. in clayey material containing carbonate of lead. Mr. Archibald told me his trials of the stuff from this crosscut averaged 20 per cent. of lead carbonate. The ore extracted from the lode in the old days is said to have been mostly carbonate near the surface. In a small parallel lode found by the present owners close to the main one, however, galena came up nearly to the surface. The present owners have raised about 53 tons of marketable galena since starting, mostly from this small lode, which has shown 3in. to 12in. in width of galena. According to the testimony of men who formerly worked in the mine they expect to get a larger lode in the bottom of the old workings, with a payable strong vein of galena upwards of 2ft. wide. The reason this mine was shut down is stated to have been because the other mines in the hands of the same owners had to be closed in 1878, partly, if not entirely, owing to the death of the principal owner, and it could not be kept on by itself. The present owners seem well satisfied with their chances of success, but at the time of my visit the lode could not be inspected underground, and I am unable to express any opinion on it further than that it is clear that the old workers must have had a fairly long shoot of ore in the main lode, and, judging from the tailings heaps, must have dressed a good deal of material. They seem to have had jigging machinery on the ground. The amount of dressed ore raised is not on record, as it was sent away without distinction from the rest of the output from the Geraldine mines.

The ore raised by the present owners is good, clean galena of great purity, and there seems to be but little zinc blende or copper ores with it. Mr. Archibald informed me that the parcels which he had sent away, which were of hand-picked ore, and ore subjected to no more dressing than could be done on a small hand jig, assayed 73 per cent. of metallic lead, without any appreciable commercial amount of either silver or gold. The poorness of the Northampton lead in silver has always been a characteristic feature.

Mr. Archibald gave me the following figures of costs of realising the ore:—

	Per ton. £ s. d.
Cartage to Northampton (about 47 miles)	2 5 0
Ore bags (used twice)	0 3 0
Railway charges to Geraldton .	0 4 0
Wharfage and shipping charges	0 4 0
Freights to Cockle Creek (New South Wales)	0 17 6
Charges at Cockle Creek	0 2 0
Returning and other charges at Cockle Creek smelter (Sulphide Corporation's works)	1 5 0
Total	5 0 6

The ore assayed 73 per cent., from which deductions were made of first one unit and then 10 per cent. of the balance, or 8.2 units, payment being made on 64.8 units. The lead was valued at 50s. below the price of soft lead on a quotation which is said to be generally somewhat below the London price, as quoted in the daily newspapers. Thus, with lead quoted in the newspapers as at present at about £14 per ton, the purchase price at Cockle Creek would be about £11 per ton, and 73-unit ore (64.8 per cent. net) would fetch about £7 2s. 6d. per ton. Deducting the above-mentioned charges, £5 0s. 6d. per ton, the ore is worth, say, £2 2s. per ton at the mine. It is obvious that for this to be payable the ore must be very cheaply mined, and if the price of lead falls lower than its present figure there is not much hope that the ore can be profitably exported. In July, 1907, when the owners sent away their first parcel of ore to Cockle Creek, the quotation for lead was £19 10s. per ton (London "Public Ledger," £19 15s. to £20 15s.), and the fall to the vicinity of £14, as at present, has been very serious to them.

The owners of this mine have, therefore, been considering the question of smelting their ore themselves. There is said to be limestone about four miles away, which might serve for the necessary flux, and York gum firewood is fairly cheap, costing at present 12s. a cord delivered in 5ft. lengths, or 15s. a cord in 3ft. 6in. lengths. Smelting, however, must stand over till the mine is far more thoroughly opened, and supplies for steady running of a furnace are in sight. In the meantime, it is proposed as soon as possible to get a small dressing mill, to enable the galena to be concentrated from the second-class ore. The owners of this mine appear to be making an energetic effort to bring it to success, in spite of the great handicap under which they labour

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by being so far from the end of the railway at Northampton, and in having to send their ore out of the State to be smelted.

Geraldine Copper Mines.

There was no one on these mines at the time of my visit, and nothing could be seen of the underground workings. The old ground has been recently taken up again, as M.L.'s 73 (Mitchell's Four-Mile Pool), 93 (Mitchell's Four-Mile Pool Copper Mine South), and 92 (Geraldine North). The main mine workings are on M.L. 73. This ground was taken up as lease 11 in March, 1897, and was held and more or less worked till forfeited for non-payment of rent in July, 1903, but was taken up again almost immediately, and held till July, 1905, when it was again forfeited. It was again taken up in January, 1906. In July, 1901, the manager, Mr. Arthur Teague, made a report to the hon. the Minister for Mines, from which I have taken the following extracts (Mines file 3619-01):—"When the present syndicate took over, there were only two small prospecting shafts, marked B and E on the plan. The B shaft was 48ft. and the E shaft 32ft. Since then we have continued B shaft to 108ft., sunk a new vertical shaft, A, to the 140ft. level, and a new incline shaft, D, to the 113ft. level, besides all the numerous drives and crosscuts shown on the plan. We were seriously handicapped by our pump giving out at the 140ft. level, and not being able to get down with the vertical shaft through the lode, we came back then in the upper levels, and picked out about 100 tons of the best grade ore, which returned us approximately, net, £1,200, our only return after an expenditure of £9,000. Our low-grade ore we have had to cast on one side on account of not having a concentrating plant to dress it up so as to get a profit." Mr. Teague adds the following information about some other mines in this district, which is worth quoting for purposes of record:—"Besides the development work done on the Geraldine copper mine, we have sunk prospecting shafts on the Wheal Margaret, Gibson's lease, Tumbarra, and Henning's. When abandoning these leases I have left the shafts securely timbered, so if anyone else cares to continue there would be little or no danger of continuing operations at the bottom of the shafts without having to go to the expense of put- shaft, 125ft., close timbered; Gibson's lease (block 30), 76ft., close timbered; Tumbarra, 32ft., close timbered. We have also done about 700ft. of driving and rising in the above mines."

There was a proposal to bore with a diamond drill to test this lode at a depth of about 500ft., when other boring was in progress, in 1902, in the Northampton district, but it appears to have come to nothing. Mr. W. D. Campbell, assistant Government geologist, reported on the proposal, after inspecting the mine, which was then working. He says:—"The depth of the main shaft is 140ft. I inspected the crosscut at 108ft.; the lode shows a thickness of over 20ft., carrying veins of black sulphide of copper for 6in. to 12in. thick, with native copper in places in the joint planes." He considered that "the lode of the Geraldine copper mine is a good one, and its value thoroughly warrants the bore being undertaken, and, although my examination did not amount to a sampling of the mine, I consider that if the present character of the lode be maintained at 500ft. it would justify developing."

Mr. W. G. Gibson, the present lessee of the mine, states in a letter dated November 7, 1907, that "the work done on the mine consists of a shaft to the 60ft. level, with drives north and south about 100ft., also crosscuts through the lode, a shaft to the 108ft. level, where drives have been put along the lode to about 174ft., with several crosscuts which show the width of the lode to be about 30ft. from wall to wall. A main shaft has been sunk on the west side of the lode, which it cut at 130ft., and was carried down 10ft. (140ft. in all) into the lode, and a diagonal drive of about 30ft. into the lode." Elsewhere in this letter Mr. Gibson says about 100 tons of ore were shipped altogether from this mine.

From the plans in Mines file 3619-01, it appears that the course of the lode was N.E. and S.W., with dip to N.W. of about 70deg. A very fine piece of ore, said to come from the 140ft. level of this mine, was shown to me by Mr. Mitchell, of Geraldine, consisting of excellent copper glance, with some galena and blende.

The Geraldine copper mines are a short distance north of the Murchison River, about four miles south of the Kingdom Come or Mary Springs mine, and four miles N.E. from the old Geraldine lead

so far as I could learn nothing was being done upon them at the time of my visit. Some of them are lead mines, some copper. There are also several old mines on private property, many of which were worked by the owners of the Geraldine lead mines prior to 1878. The Wheal Florence, on location 2, was one of these, and is said to be worked down to 150ft.

Geraldine Mines (Location 1).

These mines were opened in 1857, and worked more or less to 1878, and appear to have been fairly extensive and to have had a large amount of valuable machinery installed upon them. They are fairly fully described in Mr. Woodward's "Mining Handbook" of 1895. In November, 1907, an application was made by Mr. Robert Darling, of Geraldton, to the hon. the Minister for Mines for assistance under the Mining Development Act 1902, in re-opening these mines, which are on freehold property (Habgood's Estate). Mr. Darling says:—"Many years ago this mine was successfully worked by Mr. Habgood, who shipped to London several thousand tons of lead. It no doubt is the best lead mine in the district, but owing to the unfortunate position of the shafts (4) in the bed of the Murchison River, the floods filled all shafts, and those have remained full for many years. At 320ft. on the underlay the lode is 2ft 6in. wide, solid galena, assaying from 65 per cent. to 75 per cent. This information I gained from Mr. Samuel Mitchell, of Northampton, who worked the property for many years. Actual quantity of lead shipped from Geraldton cannot be stated, but the Geraldine property forwarded 6,500 tons on Habgood's account." In reply to Mr. Darling's application the Minister stated his willingness, subject to a favorable report being obtained from his officers, to advance the sum of £1,000, conditionally upon the applicant providing £4,000 to be expended in sinking a main shaft and in the purchase of air-compressing, rock-drilling, and winding machinery.

There is nothing to be seen on the mine now but old shafts full of water, remains of old dumps, scraps of machinery and ruins of the old mine buildings, which were originally built of stone. There seem to have been extensive dressing floors, and about three miles to the south a large chimney, which is a very prominent landmark for many miles around, shows the site of the company's old smelting works. I was informed that very good refractory stone of clayey nature was found in the neighbourhood, and largely used in building the furnaces.

At the mine, Mr. Mitchell, jun., who has his station homestead there, pointed out where floods had filled the river to a height well above the walls of the old engine-house, probably 15ft. to 20ft. above the collar of the main shaft. The river floods pretty often, running strongly nearly every year. The lode runs right along the river bed, and it seems doubtful if adequate protection against floods can be secured at any practicable cost. The main shaft might be set back on the north-western bank of the river, out of reach of floods, but there are already numerous openings to surface along the old workings, and these would have to be securely closed before flood waters could be kept out. All mullock and ventilation passes would also have to be built up on surface beyond flood level and made water-tight, and even then the flood waters would doubtless get down into the mine through crevices in the rock to a serious extent. It is, therefore, clear that it will be a very expensive and difficult matter to re-open this old mine successfully, and I fear very much that it can hardly be regarded as a practicable proposition.

The Geraldine mines form a group by themselves, separated from those of the main Northampton field by a long stretch of country, in which lodes have not yet been found. About 12 miles south of the Geraldine lead mine the road rises on to a sand plain, where the older rocks are quite covered by more modern strata. The sand plain is about eight miles in width, and is a great obstacle to cartage,, but there, fortunately, is a good well of fresh water nearly in the middle of it. South of the sand plain the old rocks re-appear, but so far as I have ascertained, there are no mineral lodes opened up until we get to the vicinity of Yiapa Spring, about eight miles from Northampton railway station.

Yiapa M.L. 76.

There are old workings, as shown on the geological map of the district on two lead lodes near Yiapa Spring, and in 1906 a lease was again taken up on the western one of these. Mr. Jas. Reynolds, who had worked the mine over 20 years before, and who had again attempted to open it about 1900, pegged out the ground and started to sink a new shaft.

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He states that the ore in the old days was sold by him, delivered at Northampton railway station, for £5 per ton, which was payable, but that on his second attempt to work it in 1900 the smelting charges of £5 2s 6d at Fremantle and other expenses left him no profit. At the time of my visit I was informed that no one had been at work on the mine for some time, and did not therefore go to it.

Baddera Mine.

This mine is rather under seven miles north from the Northampton railway station, on freehold land (location 1472), belonging to the Fremantle Smelter, Ltd. This mine was working quite lately, during 1907, but owing to the company going into voluntary liquidation, it had, unfortunately for the district, to be shut down.

The manager of the Fremantle Smelter, Ltd., Mr. W. G. Sutherland, has been good enough to give me a good deal of information about it. From an old report by Mr. A. J. Lockhart to the W.A. Smelting Co., Ltd., dated October 25, 1898, it appears that the work done by that company was as follows:—"A prospect shaft was started and sunk to a depth of 40ft. A winding plant and poppet legs were erected and a main shaft started 70ft. off the lode and sunk to a depth of 161ft. and timbered down to 138ft. At 150ft. a crosscut was put in to intersect the lode. This crosscut was in 42ft., and from indications was evidently nearing the lode. No. 2 shaft, an old prospect shaft sunk on the lode on the north end of the block, was cleaned out and sunk a further depth of 11ft, making a total depth of 94ft. The lode in the shaft was 3ft. wide carrying small seams of lead only." During 1907 the mine was re-opened, and Mr. Sutherland has kindly given me the following account of the operations:—"There are two lodes showing on the surface, the main or westerly one runs right through the property in a N.E. and S.W. direction; it has been worked in the old days from the surface in the S.W. corner of the lease to a depth of about 70ft. Three shafts were also sunk on the lode, the deepest of which is, I believe, 120ft. A little work has also been done on the N.E. end, where a shaft was sunk to about 94ft. on good galena ore. A considerable amount of ore was taken from the surface workings about 40 years ago. One previous company sunk a 7ft. by 4ft. shaft about 80ft. to the west of the lode, which was sunk to a depth of 150ft., they then crosscut towards the lode for a distance of 42ft., when work was abandoned. I unwatered this shaft, and continued the crosscut; at a distance of 52ft. from the shaft I encountered the lode, which was 8ft. wide at the point of intersection, and carried 18in. of high-grade galena on the footwall. I continued the crosscut to strike the parallel lode, but on reaching a point 110ft. from the shaft I stopped it, as it was evident that the parallel lode did not live at that depth, but had junctioned with the main lode above. On driving north on the lode it improved in value, and at a distance of about 20ft. from the crosscut it was 9ft. 6in. wide, with 3ft. 6in. of galena on the footwall, which would assay at least 60 per cent. lead. On driving south on the lode we encountered a horse of quartz; on getting through this the lode improved, and at a point 24ft. from the crosscut the face was 3ft. wide, showing good galena, slightly mixed with quartz throughout. In the north end, besides the 3ft. 6in. of high-grade ore, the balance of the lode carries galena in splashes and pockets, and could easily be concentrated. I am very favorably impressed with the property, and consider it by far the best in the district. When the above amount of work was done the company unfortunately went into liquidation, and work had to be suspended, and the shaft allowed to fill with water again, but could easily be unwatered within a fortnight with the present plant. The shaft is equipped with a gallows frame 45ft. high, 40 h.p. Cornish boiler, and one 10in. x 12in. double-winding steam winch. The shaft is divided into three compartments, in which are bailing tank, cage, and ladderway. During our prospecting work we raised about 100 tons of ore, from which were picked 60 tons of galena, which assayed 60 per cent. lead. The amount of zinc in the ore is only about 1.5 per cent., and silver about 3dwt. per ton. The Sulphide Corporation, who are about the only people buying lead ore at present, pay 90 per cent. of the lead contents, less 50s. per ton, at the price of lead, with a penalty of 1s. per unit for every unit of sulphur over 5; returning charge, 40s. per ton. When we were in operation we were paying 90 per cent. of lead contents at full London price, less 40s. per ton, returning charge, and 90 per cent. of silver contents at 2s. per ounce. The freight to Newcastle is 15s. per ton on 100-ton lots, and 18s. 6d. per ton under, from Geraldton. The railway freight from Northampton to this works siding is 11s. 1½d. per ton."

The caretaker on the mine told me that the total distance driven to the north at 150ft. was 43ft. and south 42ft., but was speaking from memory. At one point he said the galena vein was measured 5ft. 10in. across, the ore as broken out averaging about 40 per cent. of lead. The heap of second-class ore at surface shows a large amount of clean cubical galena through it, and would be well worth dressing. The gangue is mostly quartz, with some garnet, and the galena is associated with a little copper pyrites, iron pyrites, and blende.

The old workings must have been somewhat extensive, and the lode is said to have been over 12ft. wide. Near surface much of the lead ore was in the form of carbonate of lead, of which some very large solid pieces are reported to have been obtained.

From all accounts this mine is in a good position to make an output of ore almost at once, and has excellent galena developed ready for stoping so soon as a rise has been put through to the old workings and connected with the surface. The mine is well spoken of locally, and seems to be well worth going on with. It is a very great pity that after putting the machinery on the mine and getting it ready to commence systematic mining the company were induced, on considerations outside of this mine altogether, to shut it down and go into liquidation.

Baddera South Extended M.L. 6P.P.

On this holding, lying immediately south of the Baddera mine, some prospecting has been lately done by Mr. William Shepherd to try to find the Baddera lode, but had met with no success when I saw it.

Wheal May Mine.

This old mine lies about one mile and a quarter S.S.E. from the Baddera, on private property, part of location No. 6. The old workings extend along the lode for about 800ft., the ore having been stoped out from seven shafts sunk to the 70ft. level of the main one. The old mine had a Cornish pump, parts of which are still on the ground but quite unfit for use. At the time of my visit the old mine was quite full of water and could not be inspected.

The owner of the freehold, Mr. Chisholm, has let the mine on tribute to Mr. William Shepherd on a 7 per cent. royalty on all ore raised, with an option of purchase at an agreed amount. Messrs. Shepherd and others have started a new main shaft, which is to be carried down to 150ft. before opening out, and have erected a small set of poppet-legs, a vertical boiler, and a single drum winch, and were obtaining a steam pump, as the water became too troublesome to allow sinking of the shaft to proceed with hand labor alone. The shaft was down 42ft. at the time of my visit, but the water was in it. The country is rather hard quartzite.

The old mine is said to have yielded about 2,200 tons of clean lead ore, dressed to about 75 per cent. of lead. The galena vein is said by Mr. Chisholm, who worked it, to be up to 18in. in width, and to have been carried along in the old workings for nearly their whole length of about 800ft. Government assistance under the Mining Development Act, to the extent of £300, has been granted to the owners of this mine, to enable them to sink the new shaft and put machinery upon it. There seems much reason to believe that the mine can be profitably worked.

Wheal May North.

An application has lately been made for a lease to the north of the Wheal May mine, on the line of its lode, which is seen outcropping at surface as a strong body of quartz. No prospecting had been done at the time of my visit on this.

Wanerenooka Copper Mine.

No work has been done on this mine for some time past, but in addition to the information already contained in published reports I have been able to gather from files in the Mines Office some information as to the last workings in it, which are of interest. On July 15, 1896, the Derby Syndicate, Ltd., was registered in London, and acquired blocks. 27, 37, 389, 183, 324, 325, 313, 184, 312, 311,7, and 42-336, a total of 1,050 acres. and on March 8, 1898, a company known as the Copper Estates of Western Australia, Ltd., was formed with a nominal capital of £100,000 to work the mine. Work was carried on till near the end of 1899, but, as payable results were not obtained, it was then abandoned. From a report by the manager, Mr. J. M. Thomson, dated May 20, 1903, in Mines file 6093-03, it appears that the old shaft, 240ft. deep,

had been practically unwatered when he arrived in August or September, 1898. He goes on to say:—"To accomplish this machinery had been put down by the Copper Estates, and a commencement was made to exploit the old workings at the 138ft. level. The local information led me to believe that large quantities of rich ore had been got from the mine by its former owners. The cleaning up of the old drives, cuts, and winzes, showed that this information could not be relied on. . . . . Crosscuts were driven from the footwall side of the lode to the hanging wall side; the width of the lode in some places was 30in. In passing through the lode streaks of copper varying from a mere faint mark to a few inches were found. On the hanging wall we found rather larger veins, and in some instances small pockets, from which we were able to get out a few tons of very fair ore, averaging about 15 per cent. Wherever we found a streak it was followed up, or down; generally these small veins ran out, or patches of galena took their place. After a few months of this prospecting work at the various levels, and nothing found of a payable character, we thought the only chance was to sink deeper, and for this purpose additional pumping machinery was put down. . . . Sinking was gone on with for, I should say, another 50ft At this point the shaft had struck the hanging wall side of the lode. From this point levels were opened up, and a crosscut started to cut through to the footwall side; we had only reached a distance of 4in. to 5in. when we struck country rock. It appears that the lode in its downward trend had narrowed itself out so that the two walls came together. Mr. Gibson, M.E., Northampton, was called in to report on the mine, and on his report and the disheartening letters sent home by myself, it was agreed to stop the mine. During the period of our prospecting in the Wanerenooka other blocks belonging to the company, as also others they were interested in, were being tried and found barren. The surface indications in some of them looked well enough, but that was the whole of it." From August 1, 1896, to October 18, 1899, the company remitted to Western Australia for the purpose of working this mine a sum of £16.550, inclusive of £5,500 spent in acquisition of the property. In consequence of the unfavorable reports received from their manager, the company was wound up on November 17, 1899, but as the liquidator could not dispose of the property it was 1903, a new company, also called the Copper Estates of Western Australia, Ltd., was registered.

From such information as is contained in the above report, and as could be got locally, I am not altogether satisfied that the trial of the mine given it by the Copper Estates Company was a very conclusive one. They do not appear to have done much beyond cleaning out the old workings, making a few crosscuts, and sinking the shaft. Naturally the old workings would have been depleted as far as possible of ore before the previous workers abandoned them, and somewhat extensive development work would be required to find new ore bodies.

The mine was first discovered in 1842, and was worked for several years, but no information is now available as to its output of ore.

Early in 1903 application was made to the hon. the Minister for Mines (Mines file 3307-02), on behalf of the owners of the mine, for assistance in putting down two diamond drill bores, one on the Wanerenooka mine, the other near Martin's Spring, or on block 324. There were stated to be nearly a mile of drives, crosscuts, winzes, etc., in the mine. The application was reported upon by Mr. John Provis, but as the mine was full of water he could only go by information obtained locally. He was informed that at the 180ft. level, at about 120ft. from the shaft, in a N.E. direction, there was a winze sunk 60ft. on a bunch of black copper ore of good value, averaging 10in. in width. The walls of the vein were said to be 30ft. apart, with veins of good ore on the hanging and foot walls, 10in. to 12in. wide. The 180ft. level is said to have been driven 200ft. to the N.E. Mr. Provis recommended pumping out the mine and driving on the lode at the bottom level as being preferable to boring. The hon. the Minister thereupon made an offer to the company to advance a sum of £1,000 under the provisions of the Mining Development Act 1902, on the basis of expenditure of £1 for £1 in unwatering the mine and crosscutting and driving at the lowest level, conditionally on their providing a sum of £5,000 with which to work the mine, but no reply has been received.

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Nooka Mine, M.L. 115.

During 1906 this old mine was taken up again as a lease, M.L. 74, and an

gether to work it, but the efforts proved abortive, and the lease was surrendered in November, 1907. I visited this old mine, but can add no information to that already published. The old workings evidently were rather extensive, and from what one can see in the shallow workings, the lode was a distinct fissure vein. Much of the lodestuff seems to be altered dyke rock, as at the Kingdom Come, previously described. The dumps show a good deal of second-class ore, consisting of quartz, galena, blende, and copper pyrites, while carbonate of lead is fairly plentiful in the weathered material also. The blende is in considerable quantity, and copper stainings numerous. Mr. Woodward's report of 1901 says that the mine was worked to about 90ft., and is said to have produced about 1,000 tons of ore. Appearances give grounds for thinking this mine well worth trying again.

Chiverton Mine, M.L. 99.

This lies south of the Nooka, but had comparatively little work done on it. The refuse on the dumps is poor in lead.

Kirton's Mine (M.L.'s 100, 101, 102, formerly leases 1, 2, and 3).

Some information is given about the work done by the Western Australian Smelting Co., Ltd., in Mr. A. J. Lockhart's report of October 25, 1898, above referred to as kindly lent to me by Mr. W. G. Sutherland. He says:—

"Lease 1.—No. 4 shaft was started from a depth of 10ft. and sunk a further 40ft. Total depth from surface, 50ft. A crosscut east was put in 14ft., passing through a lode formation about 3ft. wide, of poor quality.

"Lease No. 2.—No. 1 shaft was sunk from a depth of 20ft. to 48ft., and holed through to old workings at this depth.

"No. 2 Shaft.—A start was made to unwater and repair this shaft, which was found to be a depth of 88ft., sunk on the lode. Sinking was continued a further depth of 34ft., making a total depth of 122ft. In an old drive 70ft. from the surface a considerable amount of work was done on the lode, which was composed of quartzite intermixed with galena. At 117ft. crosscuts were put in east and west through the lode a distance of 16ft. meeting with hanging and foot wall. The lode is chiefly quartzite, carrying small bunches and seams of galena. This lode would not average 10 per cent. of lead.

"No. 3 Lease.—No. 3 shaft was an old shaft sunk on the course of the lode. This was cut down and timbered to a depth of 30ft. (water level). At this depth a drive was put in north on a small shoot of ore which did not continue more than 15ft. This shoot having been stoped out to a height of 12ft. (where it pinched out), the drive was extended to a distance of 40ft. on lode formation, carrying only traces of lead. Prospecting work by means of costeening was carried on, but did not lead to any promising result. Ten tons of ore in all were raised from these leases."

Ryhope (formerly Taffy's Mine).

This lead lode is shown on the geological map crossing the S.E. corner of lot 17, but is not mentioned in previously-published reports. It is on private property, and is being worked by Messrs. Pearse and Smith on a royalty agreement. They have sunk a shaft to a depth of 64ft. in the footwall of the lode, and crosscut to it at 40ft. and 58ft. The top crosscut is 9ft. to the lode, and broke into the old stopes; the lower one cut the footwall at 15ft., the underlay of the lode being about 1 in 4. Where cut in the bottom level the lode is about 18in. wide and poor, but well defined; but in driving south about 12ft. it improved, and widened out to 4ft., carrying a good percentage of clean galena. It is not quite clear if the lode has been completely cut through by the crosscut, which should be extended. The drive struck the bottom of an old shaft, coming in about 3ft. lower than this, and is barely below the old bottom level from it. It is, therefore, useless to extend the 58ft. level, and the shaft should be sunk deeper. The prospectors, however, have only a hand pump to deal with the water, which is rather too heavy for them without machinery. About a ton of good clean lead ore has been saved from the small piece of lode which has been broken, and the remainder would be worth dressing if it were being won in quantity. The lode appears to be in a weathered greenstone dyke, in the usual gneissic country. This is a fair little prospecting show, and the owners have been working very hard to make it a success, and deserve encouragement. The old workings do not seem to have been very extensive.

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Victoria North and Victoria Copper Mines.

The lode in these two properties is on the east side of the Northampton townsite, and has been traced by a series of shafts and old workings for a long distance The ground has recently been applied for, in 1907, as M.Ls. 84, 85, and 86, but no recent mining work was visible at the time of my visit. There is said to be a strong influx of water into this mine, which fills the old workings almost to the surface. The deepest shaft is said to be sunk about 70ft., but there is no very good authority for this. The lode stuff appears to be dyke material, much kaolinised and silicified, and the dumps show very little ore. At two or three places I saw a little blue and green carbonate of copper, and there is said to be some copper glance. There is a great deal of iron pyrites in places. From present appearances I should much doubt if there has been any considerable quantity of copper ore found in this lode. It is, however, a very strong and well-defined vein.

Cook's Mine, M.L. 105.

This lease has been taken up in the southern part of the Northampton townsite, on a strong lode of ferruginous quartz and brown oxide of iron, running from the Nokanena Brook south-westwards into the Gwalla mine property. A shaft has been sunk about 15ft. deep at the north end of the outcrop near the Brook, and another about 40ft. deep on the hill to the south. The lode outcrops strongly, but shows no copper or lead minerals on the outcrop, and only a very little copper in the shafts. In the north shaft the lode stuff is very hard and silicious; in the south one there is some softer iron oxide "gossan" that seems rather more favorable for ore. The lode is in a greenstone dyke, and the lode stuff is mainly silicious transmuted greenstone. The owners of this mine are anxious to put machinery upon it and test it in depth, but while there is undoubtedly a chance of success by so doing it does not seem to me that the surface prospects warrant this expense. It would be better to try to sink in the iron oxide "gossan" with a whip and horse, which should enable the lode to be tested enough to show if it would warrant more expensive equipment.

Gwalla Mine.

This old mine is on private property due south of and adjacent to the Northampton townsite. It was re-opened in 1907, under an option of purchase by the Gwalla Copper Syndicate, Ltd., of 62 London Wall, but at the time of my visit no work was in progress and the mine had water in it, preventing underground examination. According to a plan in the office at the mine there are four lodes near the old main shaft, three of which join together going southward. The fourth is a parallel one further to the north-west. There were two main shafts in the old workings, one down to 180ft., with levels at 54ft. and 108ft.; the other only down to the 108ft. level There was also a ladder shaft to the 108ft. level. South-west from the southern shaft there was a drive 102ft. long at the 108ft. level, with a rise from the end of it to the 54ft level. From this rise a short drive had been made 41ft. to the south-west at the 90ft. level. The distance between the main shafts was 320ft., and north-east from the deeper one the 108ft. level was extended 90ft. All the block above the 108ft. level is shown on the section as stoped out. Below the 108ft. level drives were made 50ft. south-west, at about 160ft. level, and 30ft. north-east at 166ft. level. and the block above these was stoped out.

Five hundred and ninety-four feet N.E. from the deep shaft a new shaft 6ft. by 4ft. has been sunk by the option holders to a depth of 104ft., and at 98ft. levels were driven 21ft. 6in. S.W., and 20ft. N.E. All these particulars of measurements were kindly given to me by Mr. Oxley, the manager for the option holders. He informed me that below the 108ft. level there was only a short chute of ore 30ft. long and about 9in. wide, which pinched out at each end. In the new shaft to the N.E. the ore was poor and highly silicious. The dump shows such ore with numerous spots and veinlets of yellow copper ore with a little earthy black sulphide of copper, forming quite low-grade ore, unfit for any treatment without concentration. Some of it might pay to concentrate, however. The lode here is said to be up to 7ft. wide.

Three samples of picked ore shipped from the mine are stated to have returned 14 per cent., 8 per cent., and 19 per cent. of copper, and less than an ounce to the ton of silver, with only traces of gold.

So far as the re-opening of the mine has shown there is very little payable ore in sight, but as in the case of the

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Wanerenooka this may be due to the old workers having very thoroughly taken out all visible ore before they stopped work. Mr. Woodward's report of 1895 states that about 902 tons of copper ore were returned, realising £16,573 8s. 5d. From this it would seem that there has been one good bunch of ore worked out, and there is a fair chance that by sinking and driving other shoots would be encountered.

Wheal Ellen North M.L. 113.

This lease is on Crown lands immediately north of the old Wheal Ellen mine. A shaft has lately been sunk 60ft. deep, in which a 6in. seam of fair dressing lead ore was cut in hard greenstone country, but this is not supposed to be the main Wheal Ellen lode. At the bottom of the shaft this little lode has been followed about 10ft. north and 12ft. south, and there is a crosscut about 8ft. At the time of my visit the bottom of the shaft was under water, which is too heavy to allow working to proceed without the aid of machinery. Further north there are fairly extensive old workings, at the north end of which a recent cut shows 12in. in width of galena ore in greenstone dyke rock. As usual in this district, the lode seems to be in more or less transmuted dyke stuff.

Wheal Ellen Mine.

This old mine is owned by the Fremantle Smelter, Ltd., and was formerly extensively worked, and had a large equipment of machinery for winding and dressing the ore. In 1898 a little work was done on it by the W.A. Smelting Co., Ltd., which is described in Mr. Lockhart's report, previously referred to, as follows:—"Two shafts have been sunk on this property. The main shaft started on the west side of the lode with the object of meeting the same at 200ft., was sunk to a depth of 63ft. and securely timbered down to 30ft., the ground passed through being very hard.

"No. 1 Prospect Shaft.—Sunk on the north end of the property on the course of the lode to a depth of 33ft. At this depth a drive was carried in 15ft., meeting with slight traces of lead. At the south end of the property a considerable amount of prospecting work was done without any encouraging results."

It will be seen that in neither of the shafts referred to by Mr. Lockhart was there much work done on the lode, the test being quite insufficient to enable its general value to be ascertained.

In a report to his company dated September 29, 1906, Mr. W. G. Sutherland says of this mine:—"The lode runs right through the property in a north-east and south-westerly direction, and has been worked from the surface to a depth of about 70ft., the lode varying in width from 1ft. to 6ft. Two shafts have been sunk on the lode by the original owners, and one shaft was sunk on the lode right on the south boundary by the old company, but was abandoned; they afterwards put a shaft down about 70ft. away from the lode, with the object of sinking to a sufficient depth and then driving in under the old workings, but operations were stopped before the lode was cut. This shaft is now more than half filled with water, but could be easily unwatered at very little cost, as it is otherwise in good condition. Around the workings there is a fair amount of stone and tailings which show lead freely, and would more than pay the cost of dressing."

Mr. Woodward's report of 1901 says that the lode has been worked to a depth of 158ft., and driven on 1,200ft., and that £16,000 worth of ore was raised. The old dumps from the dressing floors now seen on surface still carry a good deal of lead and a large amount of zinc blende, and appear to be worth retreatment. There seems much reason for regarding this mine as one worth re-opening.

New Venture M.L. 1PP.

About seven miles E.S.E. from Northampton, on Location 2807 C.P. 6120/55, some mica has been found, and a mineral lease was applied for in 1905. Mr. W. D. Campbell, assistant Government geologist, examined the find, but saw no mica more than about 3in. by 3in. in size, and mostly of inferior quality. He did not consider the discovery of any importance.

Norman's Well Lead Mine, M.L. 79.

This mine is about seven miles S.E. from Northampton, and is an old one, which has recently been taken up again. There is a big silicious outcrop running N.N.E. and S.S.W. along the crown of a hill of quartzitic sandstone country. There are two shafts on the lode; the southern one is said to be 80ft. deep, and has been re-opened to 35ft. In some stoping from it the lode is seen to be about 3ft. wide,

and to have smooth, well-defined walls, being of "fissure-vein" type. A small amount of good galena was obtained from these stopes, which had been missed by the old workers. The water is said to be heavy in the old deeper workings. The northern shaft is some 8 or 10 chains further north along the lode. The present workings are confined to open cuts 10ft. or 12ft. deep on the outcrop. In these the lode is up to 7ft. wide, with smooth walls underlaying a little to the west. There are several straggling and ramifying veins of clean galena through the lode stuff, which is largely kaolin, and often nice bunches of clean galena are obtained. The stuff as a whole would be fair dressing material, and a good deal of the clean ore is easily separable by hand-picking. Further north, the outcrop continues strongly, being largely composed of dense quartz, and some costeens have been made across it in an adjoining piece of ground, which has lately been taken up. In these costeens the lode stuff is hard and silicious, but contains small quantities of galena disseminated through it.

About 31½ tons of picked galena ore have lately been sent out from the Norman's Well mine, costing 7s. for cartage to the railway. The sale returns were not to hand.

At the north shaft workings, the old workers seem to have done a small amount of crushing and jigging the ore, there being a small dump of jig tailings still there. These were not well cleaned, and look as if they might be worth re-treatment if the mine re-opens, and has a modern dressing plant.

The mine is said to have been rather a wet one, and the owners anticipate that they will have to put on pumping machinery before they can sink below the old workings.

Mendip (Old Lease 19, now M.L. 97).

There are two old shafts about 10 chains apart on a lode running through mineral leases 97 and 98, which lie about one mile and a half north-east from the old Narra Tarra mines. The lode has not been worked for some years past, and little is now visible, but so far as one can see it was 3ft to 4ft wide. The dumps show some blue and green copper stains and a little lead ore fit for dressing. The last work done appears to have been that described in Mr. Lockhart's report of October 25, 1898, previously referred to. He says:—"Lease 19.—No. 1 shaft was sunk on the course of the lode from a depth of 30ft. to a depth of 70ft. At 35ft. level a drive was put in south 44ft., meeting with small bunches of carbonate ore. At the 70ft. level drives were put in north and south a distance of 94ft. on a lode formation varying in width from 1ft. to 4ft., carrying occasional patches of carbonate and galena."

Old Cow Rock.

Rather less than a mile S.S.E. from the old Mendip mine there is a projecting rock which is rather conspicuous, and which proves to be part of the outcrop of a lode. Two mining leases were recently applied for here, to be known as "Chapman No. 1" M.L., 4.P.P., and "Chapman No. 2" M.L., 5.P.P., but the applications were later withdrawn. The lode runs about N. 30deg. E., and seems likely to be the same as that in the Mendip mine. One small costeen shows it to contain a little galena in a silicious matrix, hardly rich enough for mining and dressing. The lode is evidently a strong one, and seems well worth prospecting more thoroughly. The bore hole referred to in Geological Survey Bulletin No. 9 was a few chains to the north of the Old Cow Rock, and was put down to test this lode. One bore-hole in such a case was an altogether insufficient trial on which to come to any conclusion as to the value of the lode.

Narra Tarra Mine (freehold blocks Nos. 42, 336, 337, 830 and 833).

This old mine was extensively worked between 1870 and 1884, and has since been reopened twice, only to be shut down again after a short trial. It was on freehold property, and was formerly owned by the Melbourne and Champion Bay Lead Company, who had extensive dressing works, mining equipment, and a smelting works on the ground. There are two sets of workings, the main old ones being on the western lode. During last year, however, when the mine was reopened, work was confined to the eastern lode. Mr. Lockhart's report of October 25, 1898, contains a good deal of information about the work done when the mine was reopened by the W.A. Smelting Co., Ltd (now the Fremantle Smelter, Ltd.). He says:—

"In opening up the Narra Tarra mine a vast amount of dead work had to be done before beginning active mining operations. It was decided to unwater the old main shaft, and ascertain what was

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the best future policy to pursue. Accordingly a winding engine was erected. An old pumping engine was in position, but it was not possible to bring this into use for some time, owing to the non-arrival of the new pump columns. The shaft was equipped with a bailing tank, and the water taken out by this means. The shaft was in a bad state, making progress with the tank necessarily slow and expensive. By the time the bottom level was reached the columns had arrived. These were immediately put in, and the water kept down without any trouble. It was found that the mine had been worked from three levels. The 45ft., 105ft., and 165ft. levels. A start was at once made to clean up the bottom level. A crosscut had been put in 56ft., when the lode was cut and drives carried north and south on the lode. The lode above these drives had been stoped out, and the timber had decayed, resulting in the drives being completely blocked with mullock. This entailed a great deal of work in cleaning out and retimbering. The end of the north drive was met with 175ft. from the crosscut. A big lode formation was showing in the face, carrying traces of lead. It was decided to continue driving this end, which was extended another 133ft., making a total distance of 308ft. from the crosscut without, however, meeting with any results of an encouraging nature. At 220ft. from the crosscut a start was made to put up a rise, which was carried up 20ft. without any better result. A winze was started 80ft. from the crosscut, where it had been reported that there was 6ft. of solid lead. The winze was sunk to a depth of 15ft. through a lode about 6ft. wide, averaging 20 per cent. of lead, but becoming poorer as depth was attained. Driving was also continued in the south drive, which was extended another 30ft., making a total distance of 225ft. from the crosscut. The lode formation at this point is 2ft. wide, but of poor quality. At 127ft. from the crosscut a winze was started, and sunk to a depth of 20ft., on a shoot of clean galena 18in. wide. At this depth a drive was put in north a distance of 36ft., and the ore stoped out to the bottom of the 165ft. level. The lode was very irregular, sometimes pinching out to a few inches, consequently the output was small, 68 tons in all being raised from this part. Ten feet was also [illegible] south from the bottom of the

"105ft. Level.—At this level the lode is 30ft. from the shaft. For a distance of 100ft. south the old drive has been picked up. Several patches of lead were met with that had been left in the old workings; 30ft. of the north drive was also picked up. In all 15 tons of lead were raised for the work done in this level. The ends of these old drives were not reached, but there appears to be a considerable quantity of milling ore left on the walls.

"45ft. Level.—The lode at this level is about 8ft. from the shaft. As at the old levels, there were old drives north and south on the course of the lode. The north drive was taken up for a distance of 50ft. At this point a winze was started on a block of ground that had not been stoped, and was sunk to a depth of 27ft. The lode averaged 12in. wide, of carbonates and galena. Six tons of ore were turned out from this part.

Prospect Shaft.

"Four hundred feet south from the main shaft a small shaft was sunk to a depth of 32ft. At this depth 115ft. of crosscutting was done, without meeting with any traces of the lode, thus proving that the lode did not continue south.

Underlie Shaft, Main Lode.

"About 200ft. south of the main shaft a prospect shaft was sunk 40ft. on a shoot of carbonate ore. At this depth the back of the old stopes was met with. The shoot, which was 30ft. long and averaging 9in. wide, was stoped through to the surface, turning out 25 tons of lead. A new main shaft had been started by a previous company on the east side of the lode, with the object of cutting the same at about 600ft., and was found to be 123ft. deep and timbered down to 100ft. This shaft was cleaned out and repaired, a winding engine and poppet legs erected, and a start made to continue sinking. Four feet were sunk and 20ft. timbered, making a total of 127ft. sunk and 120ft. timbered.

"Eastern Workings.—A prospect shaft was sunk on the course of the lode to a depth of 58ft. At 33ft. a drive was put in north and south on the lode, which was again driven on at the 58ft. level for a distance of 82ft. A shoot of ore was met with, averaging about 12in., which continued for 30ft. This shoot was stoped out up to the 33ft. level, above which it did not continue, and apparently did not go below the 58ft.; 110 tons of ore were raised from this part. About 50ft. south from the prospect shaft a main

for hauling. At 120ft. from surface drives north and south were put in on the course of the lode for a distance of 61ft. The lode was composed of hard quartzite containing small seams of lead. A considerable amount of costeening has been done on this property without any favorable results."

The last work done, in 1907, on the eastern lode is thus described by Mr. W. G Sutherland, in a letter to me dated February 25, 1908:—

Narra Tarra.

"I unwatered the eastern shaft on this property, which was found to be 120ft. deep by 7ft. by 3ft. 4in. It is well timbered and vertical for about 30ft., and then goes down on the underlay at an angle of 17deg. from the vertical. There are splendid walls showing in the shaft, and at 120ft. the formation had been driven on 35ft. north and 21ft. south, 9in. of galena was showing in the north face and 2in. in the south. The north drive was extended to 55ft. from shaft, and the south to 34ft. from shaft, when the lead cut entirely out, and in all only about 10 tons of 60 per cent. lead galena was obtained from this shaft. Just before the lead cut out in the north drive we had a sudden influx of water, which, unfortunately, drowned a miner named Hugh Reynolds, who was working in the south face. After the shaft was again unwatered and the body recovered I found on inspection that the water, instead of coming in from the face, came from underneath, and that we had been driving on the top of an old drive coming south from one of the other shafts. I unwatered the drive, but could see nothing in it to warrant further expense, and while we were down in it the whole thing started to collapse; so I pulled all tools, etc., out of the shaft and closed it down. A Mr. Shepherd worked a lode on the adjoining property, Narra Tarra (Shenton), from which he raised about 200 tons of galena ore assaying about 55 per cent. lead. At the time of my first visit it looked as if his lode ran right into our property, so I put down a prospecting shaft about 50ft. inside our boundary, which I sunk to 50ft., and then crosscut to the boundary without striking anything."

The eastern shaft is equipped with a good boiler, winding engine, and set of poppet-heads, and work could be resumed almost at once if the company decided to continue mining.

The old main workings would require new machinery before they could be reopened. The old tailings heaps are somewhat extensive and contain a good deal of lead, and would probably be worth recrushing and dressing by modern methods.

Shepherd's Lode.

South of block 833 of the Narra Tarra property are blocks 118 and 119, on which was a mine formerly known as the "Narra Tarra Copper Mine." Near the north boundary of this a shaft has been sunk about 70ft. deep, but was not being worked when I saw it. Some fair dressing ore was lying on the dump. This is the lode referred to above in Mr. Sutherland's letter as having yielded 20 tons of clean lead ore assaying 55 per cent. of lead.

He describes it a little more fully in a report to his directors, dated 29-9-'06, in which he says: "Messrs. Goss, of Porth, are working a show on the old Narra Tarra Copper mine, which adjoins our Lease 833. This is a new lode, and they have sunk a shaft on it about two chains from our boundary, and are on excellent ore; they are still sinking the shaft, which is down about 55ft. At 20ft. they have driven on the lode for a distance of 20ft. I went down and inspected it. The lode is a splendid formation, varying from 2 to 15ft. of solid galena and carbonates. They are sending their ore to us, and we have already received 30 tons, and there are another 30 tons on the way down."

This lode is traceable on surface for some distance to the S.W., and is evidently a distinct fissure veing over 2½ft. wide. Towards the south of Block 118 there are old workings on the Narra Tarra copper lode for 300 to 400ft. in length.

The outcrop workings show a lode 2ft. to 8ft. wide, with smooth, well-defined walls, and carrying a good deal of blue and green carbonates of copper. A shaft at the north end of the workings carried galena. These old workings were recently reopened, but one of the prospecting party was killed in them by a fall of earth, and work was suspended. The surface portions of the lode are decidedly of promising appearance, but I have no information as to the results of the old workings below beyond what has been already published in Mr. Woodward's 1901 report.

M.L. 77.

On M.L. 77. to the west of block 118. two shafts have recently been sunk on about the line of the Narra Tarra wsteern lode, but the prospectors struck too much water for them to cope with, and had to leave off. A little phosphate of lead was seen on the dump, pointing to some sort of a lode having been cut.

MINERAL OUTPUT OF THE FIELD.

The figures in the tables given in the Government Geologist's Bulletin No. 9 of 1903 have had very little added to them during the years that have since elapsed, and the statements of lead and copper ore therein produced from some of the principal old mines should be referred to. The following tables contain the latest information available in the Mining Statistics of the Mines Department :—

From "MINING STATISTICS."

Return of Quantity and Value of Copper and Lead Ore produced from the Northampton Mineral Field to February 29th, 1908, as reported to the Mines Department :—

LEAD ORE.

Locality.	No. of Lease &c.	Name of Mine or Compan .	1899.		1900.		1901.		1907.		1908 to 29/2/'08.	
			Tons.	Val'e	Tons.	Val'e	Tons	Val'e	Tons.	Val'e	Tons	Val'e
				£		£		£		£		£
Northampton	54 etc.	Lady Maud Lead Mines	63.75	700	13.00	153	...	...	...	...	...	...
,,	62	Yiapa Lead Mines	...	...	30.00	195	...	...	...	...	...	...
,,	80	Ethel Maude	...	...	...	...	...	...	10.00	128	...	...
Victoria ...	51	Alma Lead Mines	19.00	212	...	...	...	...	...	...	...	...
Narra Tarra	—	Locality Generally	...	...	225.00	185	...	...	...	...	...	...
TOTAL ...			82.75	912	268.00	533	...	...	10.00	128	...	...

COPPER ORE.

Geraldine...	10 11	Geraldine Copper Mine	98.00 *	1715	...	...	38.50	277	...	...	...	...
TOTAL ...			98.00	1715	...	...	38.50	277	...	...	...	...

*Silver—490 oz. Value, £55 2s. 6d. Metallic Copper, 24.50 tons.

Year.	COPPER ORE. Quantity.	Value.	LEAD ORE. Quantity.	Value.	Total Value.
	Tons	£	Tons	£	£
Previous to 1899	...	...	...	...	...
1899	98.00	1715	82.75	912	2627
1900	...	...	268.00	533	533
1901	38.50	277	...	...	277
1902 to 1906	...	...	...	...	...
1907	...	...	10.00	128	128
To Feb. 29th, 1908	...	...	...	...	...
TOTAL	136.50	1992	360.75	1573	3565

It will be seen from the above that it is only since 1899 that reports of the output of ore from these mines have been received by the Mines Department.

The value of the Mineral Production of the Field is best shown by the Export Figures :—

From Table XX of "MINING STATISTICS."

Return of Quantity and Value of Copper and Lead Ore from the Northampton Field entered for Export from 1850 to 1903, inclusive :—

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	COPPER ORE,		LEAD ORE.		COPPER AND LEAD ORE.	
Year.	Quantity	Value.	Quantity.	Value.	Total Quantity	Total Value.
	tons	£	tons	£	tons	£
1850	...	...	5.00	55.00	5.00	55.00
1	...	...	...	...	...	...
2	...	...	...	...	...	...
3	...	7.50	...	4.00	...	11.50
4	...	...	...	...	...	...
5	2.05	26.45	25.00	250.00	27.05	276.45
6	57.00	1017.90	...	...	57.00	1017.90
7	80.00	1920.00	...	...	80.00	1920.00
8	433.25	9531.50	...	...	433.25	9531.50
9	941.50	14122.50	13.50	135.00	955.00	14257.50
1860	517.50	8021.25	98.50	985.00	616.00	9006.25
1	409.00	6339.50	79.00	790.00	488.00	7129.50
2	783.50	12536.00	9.00	90.00	792.50	12626.00
3	763.00	12208.00	230.00	2300.00	993.00	14508.00
4	1076.00	17216.00	80.00	800.00	1156.00	18016.00
5	886.00	13290.00	703.00	8436.00	1589.00	21726.00
6	557.50	8362.50	273.50	3282.00	831.00	11644.50
7	337.00	5055.00	902.00	10824.00	1239.00	15879.00
8	83.00	1245.00	1100.50	13206.00	1183.50	14451.00
9	155.00	2325.00	699.50	8394.00	854.50	10719.00
1870	6.00	90.00	1209.50	14514.00	1205.50	14604.00
1	...	...	420.00	5040.00	420.00	5040.00
2	...	...	364.00	4368.00	364.00	4368.00
3	56.50	847.50	965.50	11586.00	1022.00	12433.50
4	66.50	997.50	2143.75	25725.00	2210.25	26722.50
5	204.75	3071.25	2289.00	27468.00	2493.75	30539.25
6	279.00	4185.00	2191.50	26298.00	2470.50	30483.00
7	53.50	802.50	3955.50	47466.00	4009.00	48268.50
8	9.00	135.00	3617.50	43410.00	3626.50	43545.00
9	...	...	2775.00	33300.00	2775.00	33300.00
1880	8.00	120.00	1921.00	15368.00	1929.00	15488.00
1	...	...	1400.50	11204.00	1400.50	11204.00
2	1.50	22.50	1793.50	14348.00	1795.00	14370.50
3	5.00	75.00	1038.00	7266.00	1043.00	7341.00
4	118.00	1770.00	696.00	4872.00	814.00	6642.00
5	119.50	1792.50	465.00	3255.00	584.50	5047.50
6	249.00	3735.00	611.00	4277.00	860.00	8012.00
7	23.00	345.00	471.00	4710.00	494.00	5055.00
8	87.50	1487.50	532.00	5320.00	619.50	6807.50
9	112.00	1904.00	250.00	2500.00	362.00	4404.00
1890	8.00	136.00	213.50	2135.00	221.50	2271.00
1	...	...	25.00	250.00	25.00	250.00
2	155.00	2377.20	29.75	150.00	184.75	2527.20
3	...	...	...	...	...	...
4	...	...	...	...	...	...
5	24.00	120.00	...	...	24.00	120.00
6	...	...	...	...	...	...
7	21.15	302.00	...	4.00	21.15	306.00
8	74.53	931.50	5.00	33.00	79.53	964.50
9	586.55	9473.25	16.00	96.00	602.55	9569.25
1900	...	...	26.85	242.00	26.85	242.00
1	.50	10.00	...	...	.50	10.00
2	20.00	330.00	...	...	20.00	330.00
3	25.05	460.00	...	...	25.05	460.00
TOTAL	9394.83	148744.30	33643.85	364756.00	43038.68	513500.30

Figures for 1904-5-6-7-8 not available as the Commonwealth Returns do not Show Inter-State

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The above table shows that Copper mining in the Northampton district was at its zenith about 1864 and lead mining in 1877. The production of both metals has been considerable, being much greater than anyone would guess from the present condition of the mines, and if it is carefully compared with the extent of the work known to be done in these, it is seen very clearly that they must have contained a very good average grade of ore. None of the mines have been worked to any very considerable depth and most of them are quite shallow, so their record gives every reason to be hopeful that many of them could be profitably re-opened under the improved conditions of mining nowadays. The field also is far from thoroughly prospected, and there is every expectation that if there were a revival of mining in it many more lodes would be found.

PRICES OF COPPER AND LEAD.

As the market prices for these metals to a great extent control the question of the possibility or otherwise of profitably working mines for them, the following table, taken mostly from the Comparative Statistics to 1906 of the Metallgesellschaft of Frankfort on the Main and completed from price lists kindly supplied by F. H. Snow & Co., will be of interest in comparing the market values ruling during the various years in which the above production of metals was obtained. At will be seen the information readily available up to 1880 is not so complete as for subsequent years.

TABLE of PRICES of COPPER and LEAD in LONDON per ton of 2240 lbs.

	LEAD (Soft).			COPPER.		
Year.	Highest Price	Average Price	Lowest Price	Highest Price	Average Price Tough Copper (to nearest £1)	Lowest Price
1850	...	£17 10 0	...	...	£86	...
1	...	17 2 6	...	...	85	...
2	...	17 17 6	...	...	97	...
3	...	23 7 6	...	...	117	...
4	...	23 13 9	...	...	126	...
55	...	23 1 3	...	...	126	...
6	...	24 0 0	...	...	119	...
7	...	23 17 6	...	...	125	...
8	...	21 10 0	...	...	108	...
9	...	...	...	...	109	...
1860	...	22 6 3	...	...	105	...
1	...	...	...	...	99	...
2	...	20 17 6	...	...	97	...
3	...	20 17 6	...	...	94	...
				Standard		Standard
4	...	21 15 0	...	101 0 0	100	£80 0 0
65	...	20 2 6	...	99 0 0	...	77 10 0
6	...	20 12 6	...	95 10 0	...	72 10 0
7	...	19 11 0	...	78 0 0	...	67 0 0
8	...	19 6 0	...	77 0 0	...	68 0 0
9	...	19 1 6	...	75 0 0	...	66 5 0
1870	...	18 13 0	...	68 15 0	...	60 10 0
1	...	18 2 6	...	85 0 0	...	64 0 0
2	...	20 3 0	...	108 0 0	...	77 0 0
1873	£24 0 0	23 2 6	£21 15 0	92 0 0	...	79 0 0
4	23 10 0	22 0 0	19 10 0	89 0 0	...	73 0 0
75	23 0 0	22 10 0	20 5 0	84 0 0	...	78 10 0
6	22 0 0	21 13 0	20 0 0	81 15 0	...	70 0 0
7	21 12 6	20 11 3	18 15 0	76 0 0	...	63 0 0
8	18 15 0	16 14 0	14 12 6	66 10 0	...	55 0 0
9	19 0 0	14 5 0	13 0 0	67 10 0	...	53 0 0
					Standard	
1880	19 10 0	16 6 3	14 5 0	74 0 0	62 14 7	54 10 0
1	15 0 0	14 19 3	13 17 6	72 10 0	61 16 9	57 0 0
2	14 17 6	14 7 4	13 7 6	71 10 0	66 10 5	63 0 0
3	13 5 0	12 18 0	11 15 0	67 10 0	62 17 11	57 0 0
4	11 17 6	11 2 6	10 26	58 0 0	53 17 6	47 5 0
85	12 10 0	11 9 11	10 76	50 0 0	43 11 0	38 10 0

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Year.	LEAD (Soft). Highest Price	Average Price	Lowest Price	COPPER. Highest Price	Average Price Stand. Copper (to nearest £1)	Lowest Price
1886	£13 7 6	£13 4 5	£12 5 0	£43 15 0	£40 1 8	£38 10 0
7	15 10 0	12 17 1	11 10 0	85 5 0	46 0 5	38 7 6
8	15 10 0	13 18 3	12 0 0	105 0 0	81 11 3	73 0 0
9	14 17 6	13 0 11	12 2 6	80 0 0	49 14 8	35 0 0
1890	14 13 9	13 7 10	12 5 0	61 12 6	54 5 3	46 10 0
1	13 0 0	12 8 8	11 5 0	56 10 0	51 9 4	44 1 3
2	11 6 3	10 14 10	9 16 3	47 18 9	45 13 2	43 10 0
3	10 7 6	9 18 6	9 2 6	46 16 3	43 15 6	40 12 6
4	10 2 6	9 11 6	9 0 0	43 0 0	40 7 4	37 17 6
95	11 15 0	10 12 5	9 10 0	47 8 9	42 19 7	38 13 9
6	11 16 3	11 5 11	10 15 0	50 8 9	46 18 1	40 10 0
7	14 5 0	12 8 4	11 10 0	51 13 9	49 2 7	47 0 0
8	14 12 6	13 1 10	12 5 0	57 10 0	51 16 7	48 6 3
9	17 15 0	15 1 5	13 0 0	79 5 0	73 13 9	57 17 6
1900	18 0 0	17 3 7	15 17 6	79 15 0	73 12 6	69 0 0
1	16 10 0	12 14 1	10 2 6	73 12 6	66 19 8	47 0 0
2	12 0 0	11 5 3	10 0 0	57 0 0	52 11 5	45 2 6
3	13 17 6	11 14 9	10 17 6	67 10 0	58 3 2	52 10 0
4	13 3 9	12 2 10	11 5 0	68 15 0	59 0 6	55 0 0
1905	17 17 6	13 7 7	11 17 6	81 0 0	69 12 0	64 0 0
6	20 2 6	18 4 1	15 7 6	109 10 0	87 8 6	74 0 0
1907	21 15 0	19 1 9	13 0 0	111 15 0	87 1 8	55 0 0

*George Smith & Sons Lead Statistics.

AVERAGE PRICES OF LEAD AND COPPER IN LONDON

For each month of 1907.—F. H. Snow & Co—(per ton of 2240lbs.)

1907.	LEAD (soft). £ s. d.	COPPER (standard). £ s. d.
January	19 16 8	106 17 1
February	19 11 6	107 10 9
March	19 14 7	106 13 0
April	19 16 4	98 13 7
May	19 17 7	102 8 2
June	20 6 0	97 4 3
July	20 8 2½	95 5 9
August	19 5 3½	79 17 4½
September	19 17 6	68 8 9½
October	18 13 0	60 17 6
November	17 4 11	61 3 8
December	14 9 4½	60 0 1½

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UNIV. OF CALIFORNIA

Costs of Realisation of Ore.

In the foregoing part of this report information has been given on this head when dealing with the Kingdom Come and Baddera mines. Mr. Archibald has since informed me that by sending to Europe he can get about £6 net a ton for galena ore assaying 73 per cent. lead, delivered f.o.b. Geraldton, with lead at £14 a ton, which is about 20s. a ton better than by sending to Cockle Creek.

Smelting.

There is not much prospect of supplies of copper ore being sufficient to justify any of the existing mines in putting up smelters of their own for some time to come, and they are so scattered over a large area that there is little chance of having one central smelting works in the district that would serve for all of them, without going in for an extensive system of railways or tramways. Low-grade copper ores which can be profitably smelted close to where they are mined will not stand any considerable costs of cartage to a smelter. In most cases, therefore, when the output of a copper mine becomes considerable, local smelting has to be resorted to, unless the ore proves unusually suitable for concentration. Most copper ores suffer heavy losses in concentration, and when a mine, or group of contiguous mines, becomes able to supply a local furnace it is commonly the best policy to smelt as nearly as practicable on the spot, so as to give poor ore a direct furnace treatment. This will doubtless become the case at Northampton if any of the copper mines prove considerable producers of ore; at present they are all in such an elementary stage that there is no immediate use in considering local smelting, and all that can be done is to export the richest of the picked ore, and to concentrate the poorer stuff, as best possible, to a grade that will pay to export.

With the lead ores, the case is somewhat different, unless some of the mines develop large quantities of low-grade oxidised ores, which do not permit of successful concentration. To make the best of such ores, local smelting would be required, as in the case of the lower-grade copper ores. The outlook appears to be, however, that most of the lead ore of the field will be galena, and this has hitherto generally been in fairly pure masses, capable of easy hand-sorting, and in large-sized crystalline grains very suitable for dressing by jigs and concentrating tables. It seems, as a rule, very good dressing material, capable of being brought up to a high grade in lead. Such high-grade hand-picked and dressed material, containing 65 to 75 per cent. of lead, is not so greatly heavier than the metallic lead that would be reduced from it by local smelting that there is any great advantage in freights in sending out lead bars instead of bagged galena, and other advantages of smelting at more favorable points may, and probably would more than counterbalance the saving in freight. For the generality of the lead mines of the Northampton field, therefore, local dressing plant at the mines is indicated as of urgent necessity rather than local smelting. Should the latter process prove eventually to be desirable, the facilities for it are fairly good, Northampton being connected with the port of Geraldton by a railway only 34 miles in length. The district roads are pretty good, there are fair supplies of firewood, good fresh water is not difficult to obtain, and, as a good deal of the district is settled agricultural land, costs of living are not excessive.

The question of the best centre at which to smelt the concentrated lead and copper ores from the Northampton field is one which depends upon a good many variable factors, and, according to the changes in these, different answers would be given to it. At present, since the Fremantle Smelter closed down, there is no lead smelter in the State, and, as shown above, there appears to be some advantage in shipping to Europe rather than to New South Wales. I doubt very much if a local smelter at Geraldton or Fremantle would for some time to come be able to give such good terms to sellers of dressed ore as other smelting works in the Eastern States of the Commonwealth or in Europe, though probably in the long run the advantage of proximity to the mines would tell in favor of the local works when the production of ore became large. While working on a small scale, it is very doubtful if they could successfully compete with larger establishments outside the State. Using the Northampton lead and copper ores for smelting with rich auriferous concentrates, refractory gold ores, cyanide slags, and gold mill melting-room and other gold-bearing by-products, and dealing also with the numerous small parcels of copper ores that can be sent in from various parts of the goldfields, I think there would, however, be even now an

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opening for a small smelting works at either Fremantle or Geraldton, both of which ports would also be very suitable for ores from the North-Western coastal districts. Of the two ports, Fremantle seems to me the preferable one, as it commands the whole railway system of the State more advantageously than Geraldton, and has better shipping facilities.

Zinc.

Some of the Northampton mines contain a large amount of blende (zinc sulphide) with the galena, but the two minerals do not usually appear to be almost molecularly intermingled, as is sometimes the case elsewhere, but are commonly in fairly large distinct crystalline lumps and granules, a condition favourable for good mechanical separation. The mines which have much zinc will doubtless have a good deal of trouble with zincy fines, but as a set-off to this should produce a quantity of clean, marketable zinc ore as well as lead ore. The market value of the zinc should not be overlooked.

Dressing Plant.

For economical working it will be necessary that most of the mines in the Northampton field should have dressing plant of their own, so that low-grade ores can be concentrated that would not bear the expense of cartage to a mill, unless the latter were very close at hand. It does not seem to me practicable to rely much in this instance on central mills, unless these are connected with the mines by tramways. There are a few places where there are several mines close together, which might combine to have one mill, but the mines are mostly too far apart to allow this to be done with advantage.

Mining on Freehold Lands.

Most of the mines of this district which have been at all extensively worked are on freehold land, mostly alienated before January 1, 1899, and are, therefore, not open for mining purposes except by arrangement with the owners or under the conditions imposed by part VI. of the Mining Act 1904. In the case of lands alienated before January 1, 1899, these conditions require the would-be miner to petition the Minister to have the lands brought under the operation of part VI. of the Act, and they then have to be examined and reported upon by a Government officer as to their having reasonable probability of containing minerals, after which the Government may give not less than six months' notice to the owner that the land shall be under the operation of the Act. The owner has then a first right to take up such mining leases as he chooses on the land, subject to the ordinary mining regulations as to areas of leases and the usual obligations of mining lessees on Crown lands as to working them, but not subject to payment of any rent or royalty. Should he fail to work the leases they may be forfeited, and the land thrown open to other applicants. Such forfeited leases and such parts of the lands brought under the Act as are not taken up by the owner are then open for mining on the same terms as any other of the private lands to which the Act applies. The person desiring to mine upon any of these must obtain a permit from the Warden to enter and prospect upon the land, and he may be required, before doing so, to deposit a sum of money to cover possible damage his operations may cause to the land-owner; he must arrange, before any mining is done, the amount of compensation to be paid to the owner, and obtain such way-leaves and other rights through intermediate lands as will enable him to mine upon the lands applied for; he must obtain a mining lease or claim from the Crown, and he is also liable to certain restrictions with respect to mining within 100ft. of the natural surface, use of water and timber on the surface, and protection of the mining tenement from the land-owner's stock, and also to compensation for loss or damage sustained by the owner of land in the vicinity of the tenement by reason of the mining operations. He may make a special agreement beforehand with the owner of the land, and this is usually his easiest method of getting to work. These conditions are a great bar to prospecting, especially when the prospector goes out with the hope of finding something new, and does not know on what land he will find it. It is so much simpler and easier to prospect on Crown lands that the roving prospector is hardly likely to go on to private property unless he knows of something there which will justify him taking a lot of trouble to gain access to it. When he has made a discovery he has then a good many difficulties to surmount before he can get to work, and may have to go to considerable outlay of money for right of way and compensation besides great loss of time. It is natural, therefore, that prospectors are not at all fond of trying their luck on private lands. The Act

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gives power to the Government to resume any mineral-bearing private lands which are brought under it, by paying compensation for surface rights without any allowance for the value of minerals contained.

In resuming such lands containing base metals as were sold in the first instance without reservation of mineral rights, the Government of this State have gone beyond the practice of the United Kingdom, where such metals go with the freehold of the land, and in consequence some owners of mineral-bearing lands seem inclined to question their right to do so, and claim that compensation ought to be made for the minerals as well as for the surface rights. In some cases at Northampton the claim of the landowner is still stronger, on account of the lands having been sold under regulations of January, 1865, as "Mineral lands" at a price of £3 per acre, which was £2 per acre more than the price then charged for ordinary land. These latter cases appear to have been overlooked when the Mining Act 1904 was under discussion in Parliament, though the nearly parallel case of the Hampton Plains Estate was specially exempted from the operation of the Act by section 120 thereof. It has, therefore, I understand, been decided to lay the case of these "mineral lands" before Parliament for consideration before steps are taken to enforce sections 154 to 164 of the Act in regard to them.

While there is any doubt as to sufficiency of title to any property, there is very little hope of large mining companies undertaking operations upon it, and it is therefore of much importance that all questions as to titles given by the Act should be set at rest without delay. It is, of course, possible to secure perfect titles by making arrangements with the landowners, but in the past the difficulty of doing so has been one of the most serious impediments to the development of the field, as very large sums have been demanded for mining rights, altogether out of proportion to the present value of the abandoned or undeveloped mines, though possibly reasonable enough if these proved successful. Excessive claims of the landowners as to the value of what are after all only prospective mines can only result in the diversion of mining investment to places where conditions are more reasonable. It is on account of this difficulty that there is any necessity at all for the State to intervene with legislation as to mining on private property.

The private ownership of mineral lands in the Northampton district is the greatest obstacle to the prospecting necessary to bring about a revival of the mining industry, and in my opinion very little progress will be made unless this difficulty is grappled with comprehensively by the Government. The procedure laid down in the Mining Act for opening these lands to mining seems very fair in principle—if it is first conceded that the State can properly take steps to force mining upon private lands against the will of the owners—but it is obviously too slow and expensive to give satisfaction to prospectors and their supporters, especially when they are accustomed to the very easy conditions of obtaining possession of areas for mining on Crown lands. It seems to me that in order to revive mining in this field the conditions of taking up mining leases must be made approximately as easy as in the case of Crown lands, and I can see no way of doing this except by the Government intervening to make all the preliminary arrangements with the private owners, which now have to be made by the prospective miner. How best to effect this is a matter on which there will doubtless be much difference of opinion, and which will be better discussed departmentally, and possibly in Parliament, than, at this stage, in a report such as the present one, which is intended for publication.

Summary.

The Northampton field is an extensive one, with numerous well-defined lodes, from which there is a very creditable record of production of both lead and copper. The facilities for mining are particularly good, owing to the favourable position of the field near the coast. The lodes are of such a type that they may confidently be expected to live in depth. Water is somewhat troublesome to mines in the prospecting stage, but is not so abundant as to be any serious detriment to fairly-equipped concerns which have attained to regular working dimensions; on the contrary, the general presence of fair quantities of water in the mines is a benefit to them in providing the supplies necessary for their ore-dressing

operations. There is every reason to believe that the field is a valuable one and that it would, if properly worked, support a large mining population. To revive it the first necessity is to open the ground very freely to prospecting and testing, a liberal policy in this respect being to the advantage of private owners of mineral lands even more than to the State. For the next step, that of expanding the more promising prospects into working mines, the assistance of capital is necessary, as in almost all cases no progress can be made without winding and pumping machinery and some ore-dressing plant. In a great many cases, however, the necessary equipment of machinery to allow of working on a small scale would not require very much outlay, and small companies would be quite able to undertake the work. In my opinion, the field is very well worth serious attention from mining investors.

Mine Records.

In concluding this report I wish to draw attention to the example which the Northampton field affords of the necessity for keeping public records of the work done in mines while they are alive. The field has been opened and shut down again within the lifetime of men still surviving; yet there is hardly any reliable information now accessible as to extent and true position of the old workings, the size and value of the lodes where work ceased upon them, the output of ore from them, or, indeed, any of the most essential facts which one ought to know in order to judge if the mines can be profitably re-opened. The absence of plans of the old workings has been the cause of the death of one miner already, through his unexpectedly breaking into old workings full of water, and all through the field there will be serious danger of similar accidents every time old workings are approached. The want of proper plans and records, publicly filed, in this instance will necessitate a great deal of work being done over again at much expense that could have been dispensed with if they had been kept, and shows the necessity for improving existing records of all mines. No mine should be abandoned without having a full record of its underground workings deposited in a public office for future reference.

I have, etc.,

A. MONTGOMERY, M.A., F.G.S.
State Mining Engineer.

APPENDIX NO. 1.

REPORT ON NORTHAMPTON MINERAL FIELD.

The State Mining Engineer,—

I have the honour to submit the following general report on the above field.

At the time of my visit mining matters were not nearly so active as the high prices of the metals concerned would lead one to hope.

There is very little prospecting going on, and although some 50 or more mineral leases are in existence, most of them are lying idle. Various facts contribute towards this unhappy condition of affairs.

The closing down of the Fremantle smelters has had a prejudicial effect, not only as regards the disposal of any ore won, but also because this company owned various mines on the field in question, the closing down of which, not necessarily on account of any scarcity of ore, has acted as a set-back to other development work.

Many of the holders of mineral leases are not financially strong enough to make a success of their properties, which in most cases are old mines requiring machinery. In these cases the owners are making little or no attempt, beyond picking over the old dumps, to get to work, but are pursuing what may be described as a Micawber-like policy of waiting for something to their advantage to turn up. Where negotiations are actually in progress with firms or people of some standing, and there is reason to believe business will result, such a policy can be understood. It is also unfortunate for the progress of the district that large tracts of mineral land are private property taken up many years ago, on the owners of which there is no obligation to work. I have been informed by prospectors that they have discovered veins of good lead ore on the above-mentioned properties, where they could raise galena without delay. These reasons, together with the fact that the prices of both lead and copper have been too low for many years to admit of profitable mining, have all combined to cause the stagnation under which the field is suffering. There are signs, however, that a revival may shortly take place, and once some of the older mines are unwatered and working, the attention of the general public may be directed to the locality; when, in addition to pros-

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pecting Crown lands, it is quite possible that property owners would sell to syndicates or companies a sufficient area of their lands to enable mining to be carried on.

As the ores on this field contain little or no appreciable quantities of the precious metals, the existence of the field depends upon the price of lead and copper. At the present time these metals realise a high price, and the lodes of the Northampton district, which in the past produced ore of high quality, should offer inducements to prospecting and development companies.

Geological Features.

The characteristic feature of the district is the manner in which the gneiss and granite rocks are traversed by a number of greenstone dykes, which evidently have an intimate connection with the ore-bearing veins. These latter almost always occur parallel to the strike of the dykes, and are found at times in the dyke-stone, and at other times within a short distance of it. The Government Geologist, in his bulletin on the Northampton field, says, in reference to the above:—"Igneous dykes of this nature represent what were originally fractures in the earth's crust, which pass downwards to very considerable depths, and the copper and lead lodes fill in fissures of a similar character, which find their origin far below the limit of practical mining." Naturally some of the veins have received larger deposits of the economically important minerals than others, and the usual variations in values in different places in the lodes themselves occur.

Particulars of Workings.

In previous years many of the properties were worked by a system of open-cutting or underhand stoping from the surface. When this method carried the owners to inconvenient depths shafts were sunk either on the veins or planned to cut them at various depths. All these workings are now either full of water or have fallen in, and all that can be learnt from them is the fact of many of the veins having been open-cut for considerable distances, evidently on ore of sufficient quality to send away, as the amount of refuse on the dumps does not represent the quantity of ground mined.

Of recent years the Fremantle Smelting Company has done the largest amount of work on this field, and has spent a considerable amount of money in prospecting various old mines. After several disappointments, they appear to have obtained in the "Baddera," a very promising property. At the time of my visit work had unfortunately been suspended on this mine, and the workings were under water. The bailing and winding plant erected, however, has not been taken away, and I am assured by the manager the mine could now be worked in a week. I am indebted to Mr. Sutherland, the general manager of the Fremantle Smelting Coy. for the following particulars:—

Baddera Mine.—The depth of the shaft is 150ft. At this level a crosscut of 52ft cut the lode, which at that point was 8ft. wide, with a seam of solid galena 15in. wide. A drive north of 30ft. was put in, the value of the lode gradually increasing, until in the face it is 9ft. 6in. wide, with 3ft. 6in. of solid galena. A drive south of 36ft. was also put in. Here the lode is broken by intrusions of the country rock, but improving when work ceased. An assay from the north face over the 3ft. 6in. seam of galena gave the following return:—

Lead (Pb.)	60.8 per cent.
Zinc (Zn.)	2.8 per cent.
Sulphur (S)	12.6 per cent.
Silver (Ag.)	11.25dwts.
Gold (Au.)	.3dwts.

The remainder of the lode contains splashes of galena, suitable for concentrating. The same gentleman informs me the company's work on the Narra Tarra mine was not nearly so satisfactory. Some seven or eight years ago the main workings were unwatered, and a large sum of money was spent in development work. Mr. Kohler, the then general manager, made a report which was not encouraging. The eastern lode on this property was unwatered and prospected by the present management, and here again the results were not quite satisfactory, the lode being considered too patchy.

Wheal Ellen.—This mine is held by the Fremantle Smelting Company. Work in previous years appears to have been fairly extensive. The matrix of the lode in this case is quartz, and the dump contains a percentage of galena, which the management consider would, with a modern dressing plant, be payable.

Kirton's Line of Lode.—Three mineral leases lately taken up by Mr. J. Woodcock. From account sales between the years 1879 and 1887 upwards of 841 to

of lead ore were shipped, marked as coming from this line of lode, and realising in London £5,418. The lode has been worked by open cuts apparently only to a shallow depth. The workings extend at intervals for some 500 yards or more. Seven years ago the Fremantle Smelting Company sank a shaft to, I understand, about 50ft. in depth, and did some driving on this lode, but from the reports of that time the work did not reveal any large quantity of ore. Seams of galena were cut and followed, but they were small.

Doubtless the lodes of the Northampton district will present similar features to those elsewhere, and poor zones and places will be encountered.

Nooka Lead Mine (lately taken up by Mr. Edwards).—The lode was worked by open cuts for a length of about 200 yards. Judging from appearance of the workings the lode was from 2 to 3ft. in width; it is not possible to state what size the ore vein or veins were. The lead ore is associated with zinc blende. This is said to be more pronounced towards the north end, where it is stated the ore is chiefly zinc. A sample stated by Mr. Edwards to have been taken haphazard along the dump yielded at the Government Assay Laboratory:—

Zinc (Zn.)	18.19 per cent.
Lead (Pb.)	12.13 per cent.
Copper (Cu.)	1.04 per cent.
Silver (Ag.)	nil.

All the ore sent away from here was hand dressed. Actual records do not seem to be available, but it is stated the mine worked for some years. The open-cuts are apparently about 40ft. deep. In addition several shafts were sunk on the lode, and presumably work was also carried on from them. In the bulletin on Northampton issued by the Government Survey an analysis of a sample of zinc blende from this mine is given as under:—

Zinc (Zn.)	59.04 per cent.
Cadmium (Cd.) ...	5.78 per cent.
Iron (Fe.)	2.08 per cent.
Lead (Pb.)	0.37 per cent.
Sulphur (S.)	32.66 per cent.

The present owner, Mr. Edwards, is now sending away a trial shipment of zinc blende.

Gwalla Copper Mine.—An option over this mine is now held by an English syndicate who have unwatered it. The manager expresses himself as quite satisfied with the results of his sampling. There is no doubt that ore of high grade was produced in the early days. From a statement of copper ore raised and sold at Swansea between October, 1865, and April, 1869, it appears that 901 tons 16cwt. ore realised £16,573.

Wheal Margaret Extended.—This is a promising copper show being worked by Messrs. Kitching and Moxam. The shaft is down about 40ft., and at this level a drive has been put in some 25ft.. The lode is from 2ft. to 4ft. in width, and shows some nice ore in places consisting of the oxides and carbonates of copper, chiefly in a decomposed felspathic gangue.

Kingdom Come Mine.—This is the old Mary Springs mine, lately taken up by Messrs. Archibald and Spear. It is situated at Geraldine, 45 miles north of Northampton. The geological features here are similar to those of Northampton, with the characteristic dykes of greenstone traversing the country. In this mine the veins of lead (galena) occur in the dykestone. Two veins were worked in the early days, one of them to a supposed depth of 70ft. No records are available, the mine belonging to the Geraldine Company, and the ore being sent away as Geraldine ore. A new vein has lately been cut by crosscutting This has been opened by five shallow shafts and by trenches on apparently the same vein for some 350 feet. The seam of galena is small near the surface, gradually widening as depth is attained. At 20 feet there is a seam of galena about 12 inches in width. Twenty-two tons have been sent away by the present owners. The returns of the first parcel of 6 tons 3cwt. had been received at the time of my visit. The assay value of this parcel was 73 per cent. lead, and after deducting the realisation and smelting charges, the ore was worth at Geraldton £9 16s. per ton, from which must be deducted the freight and carriage. This parcel was sent away to Cockle Creek (N.S.W.). These returns show that at the present price lead ore can be profitably mined and shipped. The freight from Geraldton to Cockle Creek is, I understand, 30s. per ton, so that ore of this grade is worth over £8 per ton at Geraldton.

Three Sisters Lead Mine, Geraldine.—This mine, I understand, is held by the owners of the Kingdom Come. It is not being worked at present, but it is a property which should be worth further prospecting. The previous owners worked it to a shallow depth many years ago, chiefly by an open cut. Lead ore appears to be deposited in seams or lenses, ir-

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regularly in the granite, following however the general strike of the lodes in the district. Lead has been found at intervals by shallow surface working for a length of nearly half a mile. The open cut where the principal workings were was taken out about 15ft. in width. It seems probable that several seams of galena occurred at this point. In a shallow shaft sunk from the bottom of the open cut small seams of galena can be seen.

Gibson's Four-mile Pool Copper Mine, Geraldine.—This mine was lately under option to the Fremantle Smelting Co.. The option was not exercised, and the mine was not being worked at the time of my visit. I am informed there is a small seam of black copper ore showing along the 60ft. level of from 3in. to 6in. in width, and at the bottom of the workings a vein of somewhat peculiar black ore exists, samples of which are to be seen on the dump and which contains, I am informed, 17 per cent. copper and 22 per cent. lead.

Future of District.—The immediate future of the district depends to a large extent upon the re-starting of work by a strong company on the Baddera mine, and upon whether the option held on the Gwalla and Yanganooka Mines is exercised. The number of metalliferous veins discovered, the extent of country over which they exist, and the quantity of both lead and copper ore produced often under very primitive conditions, all point to possibilities ahead if opened up in an energetic manner.

The total quantity of lead ore entered for export and reported to the Mines Department from 1850 to June, 1907, inclusive, is 33,653.85 tons, valued at £364,884.00.

The total quantity of copper ore for the same period is 9,394.83 tons, valued at £148,744.30.

Making the total value of the production from the field £513,628.30.

(Signed) S. CULLINGWORTH,
Inspector of Mines.

September 11, 1907.

APPENDIX NO. 2.

Since writing the foregoing report, the following information has come under my notice in papers forwarded to the Hon. the Premier in June, 1906, by the Agent General, who had been given them Rowland Rees. The reports are reproduced hereunder as received, for what they may be worth, and without any responsibility whatever as to their accuracy.

A. MONTGOMERY, M.A., F.G.S.
State Mining Engineer.

"Wheal Fortune Extended Copper and Lead Mine."

(Location No. 436.)

Position.—The property is known as Victoria Location No. 436, and consists of 100 acres, absolutely freehold. It is situated 3 miles from the Northampton Railway Station, and 35 miles from the Port of Geraldton, to which the railway runs. There is also a good road from Geraldton. The country is well watered and wooded. Labour is plentiful. Three maps are appended.*

1. A Geological Map of the district taken from the Government Handbook.

2. A plan of the location, showing two main lodes already traced and indicating the lay of the country.

3. A section of one line of lode on which work has been done, indicating the shafts sunk.

Early History.—Some forty years since a syndicate obtained possession of two adjoining locations, and commenced work. They then purchased No. 436, sinking on it a shaft, and stoping out a considerable amount of ore, shipping to England 2376 tons of copper ore, averaging 17 per cent.; and 2732 tons of lead ore, averaging 75 per cent.

In consequence of the migration of labour to the newly-discovered goldfields, want of capital, difficulties of communication, and personal differences, the work was stopped, Location No. 436 was sold, and the other property was thrown into Chancery.

Introduction of Property to Present Owners.—Mr. Rowland Rees, C.E., for twenty-two years member for the Burra Burra in the South Australian Parliament, and an engineer and mining expert of great experience, introduced the property, sending in the following reports:—

"Report of Wheal of Fortune Lead and Copper Mine, by Captain Samuel Mitchell, F.R.G.S., member of the Legislature of Western Australia.—This property is situated about three (3) miles in a north-westerley direction from Northampton Railway Station, and immediately

which returned such a large quantity of both lead and copper ores during the time it was worked (now fully thirty years ago). Indeed, it is a continuation of the same lode, and once formed a portion of the 'Fortune' property. It was purchased by its present owner, who was one of the miners who helped to drive the level from the old mine some time after operations had ceased. It was from him, who is now an old man, that I gathered the information concerning this part of the property, as I could not get down the shaft, it having been covered over to prevent anything falling down it. This shaft, which as far as the Fortune Extended is concerned, has gone virtually in whole ground, and is therefore of considerable value to any company about to work the property, as it would be an easy matter to uncover it, recollar it, pull out the water, and start a drive at any depth and extend it in any direction of the workings to the north-east, or, even without pulling out any water, a drive could be started at water level which would give a good height of backs, and would thereby, in my opinion, lay open a large extent of very valuable stoping ground. If this plan is adopted a good horse would be sufficient to do all the hauling for some time to come.

"The other portions of the workings are some 1200 feet in a north-easterly direction from the shaft, and a continuation of the same lode.

"These workings are of a limited character; the deepest point reached is about 42 feet, whilst the others are little more than pits or holes. I was able to get into most of them, but, owing to the long time since any mining was done, naturally a large quantity of debris has accumulated, so that I was not able to make such a thorough examination as I could have desired. I saw, however, quite enough to convince me that the property is a remarkably valuable one. Indeed, at almost every point ore is to be seen. In the west end of shaft (No. 2) a really fine rich lode of galena is standing, which can be stoped away at once. I could not see the bottom of this, but I have been told by miners who worked in it that the lode is large and rich, but the inflow of water was somewhat heavy for their appliances for rousing it, and that before any materially greater depth can be obtained, it will be necessary to adopt pumping and winding gear, which need not be very expensive. Very little development work has been done yet. Something like 150 tons of high-class ore is taken out and sent away, and at this time the cost of conveying it to Geraldton, the shipping port, was not less than £2 per ton. With railway facilities it can now be done for less than a quarter of that amount.

"There is an ample supply of firewood for all purposes for years to come on this property.

"It will be seen that I make no attempt to go into details, such as the strike and dip of the lodes, the country rock, etc., deeming it sufficient to say that I have a very high opinion of the property, and I have no hesitation in saying that there are few (if any) in this great mineral district that hold out greater inducement as a copper and lead mine than this Fortune Extended, and it seems to me passing strange that it should have remained unworked so long, because a commencement to raise ore can be made at once, and without much expenditure. Anyone visiting the vicinity of this mine cannot help being struck with the general mineralogical aspect, which, to the practical eye, is everything that could be desired.

"The Fortune Extended comprises an area of one hundred (100) acres of freehold land.

(Signed) SAMUEL MITCHELL.

Rowland Rees, Esq., J.P.

Captain E. D. Davies' Report on the Wheal Fortune Extended Lead and Copper Mine, Northampton district, W.A.—

"I have the honour to report that I worked as a miner on the Wheal Fortune Mine, adjoining the Extended, but I know the latter very well. I am now an old man, but I can truly say that this mine, known as Victoria Location 436, will eventually, properly worked, become as valuable as even the Moonta, in South Australia, and less expensive in working. This mine was closed, although paying very handsomely and without railway facilities, because the miners left for the Victoria goldfields, and since that time no others were to be obtained in Western Australia, and none could be induced to come to this colony, preferring, when leaving England, to go to Victoria or South Australia.

"The lodes are very strong, more or less, north and south, 30deg. east and contain very rich copper and lead. In No. 1 shaft, which is about 200 feet

down on good ground, the ore near the surface consists of blue and green carbonates, averaging from 22 per cent. to 30 per cent. At drive No. 1 ferruginous oxides and native copper in considerable quantities. Below water level the lodes are in the main sulphides (copper pyrites, copper glance, and covellite). It is a curious fact that these last-named lodes are remarkably irregular in the underlying rock in which they present themselves, varying in width from 2ft. to 20ft., with a declination of about 1ft. 6in. to 2ft. to a fathom; when exceeding this dip, however, becoming less valuable. The specimens obtained yield from 40 per cent. to 52 per cent., as certified by the Government Analyst. The rocks proved to be the richest are granite, gneiss, porphyry, almost without cross courses, in other words, running at right angles with these, generally worked at very great advantage, is connected with the mine I am describing, viz.:— The ore is near the surface soil, so that much expense is saved in sinking shafts through dead country. The influx of water is light, and thus expensive machinery is unnecessary, and the expense of keeping the mine dry inconsiderable.

"I may inform you that a pair got out over 60 tons of high-class ore in less than 28 days, equal to about 11 tons to the fathom. The expense of cartage is almost nominal, being 17s 10d per ton to Geraldton jetty. Very little work has been done east of shaft, but the lode can easily be traced. At the northern boundary of location I examined some shallow workings, including a shaft about 55ft. down, where a fine lode of galena is close to the surface, both carbonates and sulphides—the depth being under 30ft. where found the lead retaining its primitive from the latters. From these the lead of commerce is derived. These are very rich, almost pure. Prospecting is not of a speculative nature; the lodes are visible to anyone conversant with mining; under good management ore can be delivered at Geraldton for £3 10s. to £4 a ton, which would leave a handsome profit at the present satisfactory price of lead (£14 a ton). There is a fine lead lode, some 20 to 30 fathoms in length, and in solid ground the average value I estimate at £25 to £30 per fathom the whole distance. With a horse, whim, and pumps, satisfactory returns may be anticipated. The Wheal Fortune lode crosses the Location block.

"The copper lodes are by far the most valuable and extensive, and, although the shaft No. 1 is nearly full of water, the spoil heaps contain hundreds of pounds worth of the metal, which would leave a large margin of profit dressed with modern appliances. Captain Prosser informs me that below the water level the ore comprises copper pyrites, copper glance, and black sulphide (interspersed with iridescent Peacock ore). Many tons of black sulphides were obtained within his recollection, so soft and pure that they were shovelled into bags underground ready for removal. These occurred in pockets of almost virgin purity. My opinion is that these large deposits are especially characteristic of the Northampton district generally, and this location more particularly. About 8,000 tons of copper were obtained before the mines closed down, the larger quantity from the Wheal of Fortune Mine.

"In some of the specimens gold and silver occur, and, from Mr. Rouley's analyses and assays, may, as the mines attain depth, ultimately be found valuable.

"I regard this property as a very valuable one. I have seen most of the leading copper mines from my boyhood onward, beginning on the floor, and eventually managing the largest of the mines of the Australias.

(Signed) E. D. DAVIES.

Captain Pascoe's Report on the Fortune Extended Lead and Copper Mine, Northampton district.—"I have carefully examined the above Mineral Block Victoria Location 436,, and find that the lode running through this property shows an old shaft about 21ft. from the fence forming the west boundary line. From information received I understand that this shaft has been sunk to a depth of 180 feet.

"I am not in a position to give any information of the lode on account of no lode being in sight, but I can see in the dirt rich specimens of both copper and lead ores and other strong indications of rich lodes from whence they came. Apparently the lodes run in an easterly direction, and I am informed no work has been done east of shaft. I have traced the lode up the hill to a distance of about 8 chains, where I found some shallow cuttings which had been put in, in search of the lode. Amongst the stuff thrown up from these cuttings I found some rich ore, but at this spot the lode is not visible to me on account of the cuttings having been filled in with debris. On the same line of lode, about 5 or 6 chains from the above-mentioned cuttings there is a

shaft sunk 50 feet or thereabouts. I have been down this shaft by ladder about 30 feet, and could not get any further on account of water. I found at this depth that the lode had been worked on both sides east and west for a little distance. After carefully inspecting this shaft I find that the lode shows well, and in my opinion should contain rich ore.

"With regard to this shaft, I would advise to drive west from the water level to meet another level east, which should be started in No. 1 shaft at the same time, so that the two levels should meet.

"About 120ft. east of the 50ft. shaft, and on the same lode, there is a small hole sunk, showing very good ore close to the surface. I may add that the lode on Block 334 turned out a large quantity of rich ore, which should show to the east on Block 436 that good returns may be expected.

"After carefully inspecting the Block in question, I am of opinion that it is a very valuable property, and would pay for the expenditure of money for developing purposes. I base this opinion on the many years' experience I have had in different parts of the world on mining matters.

"In conclusion I may say that my mining experience extends over a period of 50 years in Cornwall, England, Victoria, South Australia, Kimberley, and the North-West of Western Australia."

(Signed) J. PASCOE,
Northampton.

Rowland Rees, Esq., J.P.,
Northampton.

Report of Captain Arthur E. Teague.

"Northampton, W.A.
1st October, 1898.

"I now have the pleasure in submitting my report on the Northampton and Geraldine Copper Mines.

"Having been in charge of the properties for the last eleven months, I will try and explain the development work done during that period, and give as near as I can the present and prospective value of these mines.

"The copper mines are divided into two groups, which are denominated as follows:—

1. The Northampton Group.

all being situated within the Victorian Mining District of Western Australia.

"From information I have gathered, and which I have reason to believe reliable, and my own personal observations during the past eleven months, hundreds of tons of ore were got out with an average yield of 30 per cent.

"I sent away about 6½ tons from the old stopes and workings, which returned us from Wallaroo, South Auastralia, the splendid percentage of 29½, so the first quality, with ordinarily careful dressing, could be kept up to that standard.

"The ore is composed of green, red, and gray, and a rich lode of yellow ore, the whole width of the shaft, which is down 180ft.

"I also came across small pockets of black ore, or rather the remains of former workings.

"I got some splendid ore in the old stopes and drives alongside of the shaft all the way down, with an average width of about five (5) feet, and also some first-class gray ore, which assayed 45 per cent. At the 30ft. level I came across some splendid specimens, which assayed 38 per cent. There is at least 372ft. of lode to work on, and then it can be traced on to another property.

"I consider it a great pity that the mine had to be abandoned on account of financial difficulties, and that the deepest shaft could not be cleared out and another sunk 20 feet, and a little crosscutting done, then if a payable body of ore were come across, which had length and width, to sink a perpendicular shaft to the west of shaft and crosscut to the lode, and simply use the old shaft for ventilation purposes, or for cases of emergency.

"Because of the number of twists and turns in the old shaft, it would never do to fix any machinery on it, nor would do for working to any depth below 200ft. What is required is a good working capital to carry out effectively those conditions (with regard to mining appliances and machinery) which are indispensable to produce good results.

"I believe these mines (Northampton) have a great future before them, properly and systematically worked, which has never yet been done.

"There is a good supply of water for dressing purposes, and with pumping machinery there would be very little trouble in draining these mines.

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quick despatch of ore, and also for getting machinery on the ground, being only about one mile from the Northampton Railway Station, and the ore can be raised on truck for about 2s. a ton, and if worked on a large scale, with a small expense, one could lay a tram rail from the mines to the station, which would soon pay for itself.

"The timber obtainable in the neighborhood, so far as I can judge, would be only good enough to use as props for securing ground that may be stoped out, and could not be stoped out for shafts or better class work.

"Geraldton is only 35 miles away, and is a seaport town, and timber and other material could be got up as quickly and cheaply as in most places of the colony.

"A regular train service exists between Northampton and Geraldton.

"The country rock is of a gneissic order, and in the neighbourhood of the lodes is of a schisty nature, but this class of ground would require more timber to secure it.

"The Geraldine Group of mines is here described.

"I do not base the future of the mine on the native copper, but on the splendid specimens of black ore to the southwest of the native copper along the line of lode in the bottom of shaft both on the foot and hanging-walls.

Mitchell's Copper Mine.

(Note.—This is another name for the Wheal Fortune Extended.)

"I had some samples assayed, with the following results:—

Native lumps, 96 per cent. (wet process)

Native lumps, 96 per cent. (dry process)

Black Sulphide, 70 per cent.

Steel grey, 52 per cent.

Brown and grey, 47 per cent.

Samples of these I enclose to be further tested, if necessary.—Lead mines description.

"In conclusion, I have pleasure in stating that amongst these copper leases are valuable properties capable of great expansion and surrounded by circumstances so favorable that a smaller or larger profit is only subordinate to the scale upon which the mines are worked.

"The country is decidedly a copper country, and I feel justified from observations in believing that the selection is made on the main mineral belts.

"One remarkable feature about the mines is the surprisingly uniform richness and comparative purity of their ores, whereas in most of the copper mines which have come under my notice, both in this and other countries, the bulk average of the ore seldom reaches 15 per cent.

"Here we can dress the ore to at least 30 per cent., and the high grade of the ores is the stronghold against market fluctuations and the usual mining vicissitudes.

"The labour rates rank with the labour rates in the other colonies, these being £2 2s. and £2 10s. per week per man for surface men and miners respectively, as against the labour rates on the goldfields, which are £3 10s. to £4 10s. per man per week.

"The copper lodes in these mines are of moderate dimensions, but the high grade of the ore and the compactness of the copper veins, their freedom from intrusive country, more than compensate for this.

"The true nature of formation of the ore bodies is manifest by the clean and well-defined walls which encase them.

"The composition of the ore is favourable, containing, as it does, natural fluxes which render fusion easy and rapid.

"The necessary co-efficients for smelting, such as lime, ironstone, and lead, occur in large quantities.

"I believe that these great copper mines have a great future before them, etc.

(Signed) ARTHUR T. TEAGUE,

Late of Earn Bros. and Tincraft Copper and Tin Mines, Cornwall, England, and Ferreira G.M. Co., Johannesburg, South Africa."

Purchase and Testing—On the strength of these reports and of his statements, the present owners purchased the property, and commissioned Mr. Rowland Rees to test the mine, and to bring it to a producing stage. The smaller shafts at the south end of the Location, where the lode is chiefly lead of a very rich quality, 75 per cent. to 80 per cent. were cleared out, and three were roughly timbered and some driving work between was done, whilst pot-holes and costeens were made with a view to locate the lode and to test. The property also was fenced in.

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Mr. Rowland Rees, under whose direction the work was carried out, wrote:—"The wealth of the mine astonishes me; there are rich black sulphides (copper) in the drive north of water shaft F, and between shafts F and H, phenomenal deposits of galena, some 3ft. 6in. wide by actual measurement. From these 'in one morning between 9 and 12 noon, we raised, and, without sampling, bagged 31 bags of about one and a half cwt. each. These deposits are whole, and await raising.' There are indications of satisfactory and permanent copper on the north side of the creek; whilst on either side of the main galena lode, between shafts F and H, are subsidiary lodes, which from their obvious declination, must ultimately meet in one common basin in about 20ft. beyond the creek."

These statements were substantiated by Captain Rosser to Dr. Rees when he went out. Captain Rosser had been a working miner on the mine in its early days, and acted under Mr. Rowland Rees as working captain. He has since died.

Unfortunately Mr. Rowland Rees was taken seriously ill, becoming mentally affected; and since his breakdown and subsequent death nothing has been done, but there are still some tons of 75 per cent. lead at grass.

During the progress of the works, Captain Gibson, formerly of Broken Hill, visited the mine, and wrote the following report:—

"Northampton,

20th February, 1900.

"Rowland Rees, Esq.

Dear Sir,—On my visit yesterday to your mineral property called the 'Fortune Extended,' I gave particular attention to the copper-bearing portion of it. The copper lode runs from the flat into the hill, with a course of south and west 30ft.; the course of the lode can be followed by the external indications, and in places has been tapped by short shafts, especially on the south or furthest side of the hill, where a considerable heap of debris, to some extent mixed with ore, exists.

"The mullock heap, at the mouth of the main shaft, which has been sunk 20 feet from the northern boundary fence, is large, and contains a considerable proportion of copper and some lead ore, clearly indicating that a large body of ore must have been extracted during the time the mine was worked. After noting all the visible external points, I had a prolonged conversation with Mr. Roper, now a farmer and selector, who formerly worked as a miner in the "Extended," who furnished me with information regarding the internal workings in the mine, from which it appears that a main shaft was sunk to a depth of 180ft., and from the bottom of the shaft a drive was put in for 60 fathoms, equal to 360 feet. The size of the drive is 6ft. by 4ft. wide. From it a large mass of copper ore was raised, averaging from 28 to 30 per cent. metallic copper, as is borne out by the tabulated statements in Mr. H. Y. L. Brown's report, dated 1871, after which the mine was discontinued working. I may mention that Mr. Brown was well known to me in South Australia, for which colony he has held for many years the post of Government Geologist. Mr. Brown's reputation stands very high, both for professional skill and integrity.

"Starting from the same level and in the same shafts a drive north 30deg. west has been put in from the Extended's ground into the ground belonging to the Wheal Fortune for a distance of about 3 chains, but, as no stoping has been done on this part of the lode, and very little on the line of the south drive, the mine is, with the exception of the area of the drives practically virgin ground, the drive being 6ft. by 4ft. is just sufficient to prove the existence of the ore, leaving the entire body of it, minus the contents of the small drive, intact.

"Mr. Roper states that all along the length of the drives the ore presents itself equally strongly, both underfoot and overhead, as well as in the faces.

"As the drive is 180ft. below the surface and the hill rises from the shaft to a height of 160 feet above it, it seems reasonable to assume that 240 or 250ft. may be taken as the medium height of backs to be stoped out from the 180ft. level underground. In view of effectively working the great body of ore contained in the mine, I should advise, instead of attempting to tinker up old shafts, the sinking of a new main shaft of, say, 15ft. by 5ft., giving in the clear a good working shaft 14ft. by 4ft., at a point not far from the old shaft, and sufficiently near the line of lode so as to cross-cut easily into it. Mr. Roper, as knowing the ground well, might be consulted as to the best position. The work should be done entirely by contract. Mr. Rogers' estimate of the yield of copper ore from each fathom is about 3 tons.

"Lead Lodes.—From what I saw of them, they look even better than when I

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saw them on the occasion of a previous visit, but from the defective mode of the old working, a great deal of dead work will have to be done before getting them into good trim, and a good-sized shapely shaft will have to be put down when the lodes are more fully examined, and the best way of working ascertained."

(No signature is attached.)

Evidence from the Old Company's Papers.—Further and completer evidence of the value of the proprety has strangely come to hand. There has been obtained from the Court of Chancery the tut-work sheets for the three years when the mine was worked forty years ago, with the manager's reports, plans of the shafts and levels, width and value of lodes, assay sheets, and money obtained. Here then was positive evidence which none could gainsay.

In this way the old manager of the mine was discovered—Captain James Penberthy, of Lelant, Cornwall; and he wrote a report on the whole. It must, however, be noted that he deals not only with Location No. 436, but with the two adjacent locations as well, although the greater part of the work was done close to the borders of that location, the whim shafft being, in fact, sunk 23ft. inside its boundary. Captain Penberthy has since died.

"Lelant, Cornwall,
30th June, 1899.

"I beg to report as follows on the Fortune Copper Mine, Western Australia:—

"Its situation is about three miles due west from Northampton, in the district Victoria of that colony.

"I was appointed to the management of this mine by a London company in the early part of 1863, and left for the mines on the 16th of March of that year, arriving about the middle of June following.

"In the meantime the directors in London despatched to the mine by the ship 'Hastings' fourteen practical miners and two mechanics. with engine and pit work for the working of the mines. These arrived at Geraldton, Champion Bay, in four months, and within a few days arrived at the mines.

"On my arrival there I commenced to inspect the underground works, and discovered that there was little ore ground available for stoping, everything of value having been taken away from the 30-fathom level, where the lode averaged 4ft. wide, and produced 6 tons of ore per fathom, composed of 4 tons of copper and 2 tons of lead.

"On the arrival of the miners I commenced driving the north-east end of the 30-fathom level with four men, which up to that date had been extended about 200 feet from the old main shaft. The lode was small, composed of clay and quartz ,but had a well-defined foot and hanging-wall, and was letting out a little water.

"I continued to drive this end for about 120ft., when we came on a body of copper and lead ores, chiefly the latter, producing about 3 to 4 tons per fathom. The lode was 3 to 4ft. wide, and this shoot of ore continued for 140ft.

"Its dip was south-west at an angle of 30deg., which appears to be the dip of all the shoots in the mine, both copper and lead.

"I proved this shoot to continue to surface, as well as below the 30-fathom level, and at some points it produced from 5 to 6 tons per fathom. Hundreds of tons of ore were shipped from this place as broken in the mine, assaying 75 to 80 per cent. for lead, 5 to 6 ounces silver, and from 2 to 3 grains gold per ton.

"After driving through this shoot of ore I commenced to sink a new whim shaft (called Sampson's shaft) from surface, 8ft. by 4, and communicated to the back of the 30-fathom level in about six months from commencement.

"During the sinking, as soon as was possible, I drove the 12-fathom and 20-fathom levels south-west from this shaft, and intersected the above-mentioned shoot of ore in the back of the 30-fathom level.

"A good portion of the ground thus opened up has been stoped away but there remains yet a large portion of ore ground that can be taken away at a cost of 5s. per ton. I estimate the quantity at 1000 tons, which can be got at as soon as the water is drained to this level, without further development.

"30-Fathom Level, North-East End.—This has been extended from Sampson's shaft about 50 to 60ft. in a lode, which in places was 3ft. wide, containing specks of lead ore in quartz.

"In passing through this distance, we met with a cross-course of mica schist, which temporarily interfered with the lode.

"This drive I should recommend to be extended with all possible speed, as I believe in so doing shoots of ore similar to those passed through would be met with.

"30-Fathom Level, South-West End.—This end has been driven about 140ft. from old main shaft. The first 84ft., as you will observe from the plan, was through a copper lode that produced

from 2 to 3 tons per fathom, but this was all taken away to surface previous to my taking over the management. The present end is out of the run of ore ground.

"Old Main Shaft.—I commenced sinking this to the 40-fathom level through a lode of copper ore, varying from 2 to 4 tons per fathom.

"This productive ground continued to go down in the bottom of the shaft, as well as to the north-east and south-west of it.

"40-Fathom Level, North-East Drive.—This is extended about 200ft. For the first 30ft. it was through a lode of copper ore from 2 to 3ft. wide, producing from 2 to 3 tons per fathom, and is a continuation of the ore shoot stoped from surface. It was from the stopes in the back of this level that I had raised one stone of copper ore, which weighed nearly half a ton, and samples of which assayed 17 per cent. copper. This was sent to the Melbourne Exhibition of 1861 or 1865.

"The next 100ft. was driven through a lode 3ft. wide, composed chiefly of quartz, having a very promising character.

"The remaining distance of 70ft. was through a similar lode, with lead ore scattered throughout it.

"Somewhere in the last distance I have communicated to the 30-fathom level by a winze, and in this distance passed through different shoots of lead ore, which I was in the act of stoping when the mine was stopped.

"The lead ore in the back of this level had to be concentrated, as it was mixed with quartz. We succeeded in dressing it up to 80 per cent. lead ore.

"The lode in the present end, if I remember rightly, is about 5ft. wide, composed of quartz chiefly with stones of lead ore, and can be driven for about 20s. per foot. The ventilation here is all that can be desired, in consequence of the winze before spoken of.

"40-Fathom Level, South-West End.—This is driven 70ft. in a lode 3ft. wide, composed of quartz chiefly, and produced about 2 to 3 tons of copper ore per fathom.

"For the first 40ft. we had a good shoot of ore, stones of which I have in my possession now. The present end is south-west of this shoot, and can be driven for 15s. to 20s. per foot.

"Crosscut.—At the 30-fathom level, about 60ft. south-west of the old main shaft, a crosscut was driven in the hanging-wall 30ft. At this point a lode was cut, producing from 2 to 3 tons of lead ore per fathom.

"The south-east drive on this lode was only driven a few feet, the end being poor.

"The north-east end was extended, I should think ,over 30ft., and a large quantity of lead ore was taken out from these stopes. There is still a large quantity of ore left here, and it continues in the bottom of the level.

"From the bearing of this I think it will form a junction with the main lode going north-east. The small amount of exploration done on this lode, as well as others, was consequent on not having sufficient capital.

"Old Main Shaft.—This is sunk to the 40-fathom level, following the varied dips of the lode, and consequently cannot be used for any practical purpose.

"New Main Shaft.—This shaft is sunk perpendicular to a few fathoms below the 40-fathom level, where it intersected the lode. Its measurement is 12ft. by 8ft., divided into three compartments—skip road, ladder way, and pump way. After this shaft was completed to the level named, we had our pumping and winding engine of 12-h.p. fixed near this shaft in a substantial manner. This commanded the winding of all the ore, pumping water, and crushing ore separately. A pump with 6in. lift placed in this shaft proved quite large enough to deal with all the water we encountered.

"The first 20 fathoms of this shaft from surface was through a hard gneiss formation, this being the character of the rock in this district.

"From this point to the bottom the ground became much easier, and from what I remember of the nature of the ground the shaft must have long ago fallen in, as the water has been in for over thirty years. So that, were the mine started again, I could not, for the above reason, advise you to open up this shaft.

"The only permanent shaft, I think, may be of use to the mine is the new whim shaft (named Sampson's shaft), at the head of the gully. (This is not marked on plan.)

"This was sunk in hard gneiss rock, and was to command the run of ore ground in the back of the 30-fathom level north-east; but even this, I am afraid, will be too far north-east to command the south-west part of the mine.

"Under these circumstances you will find it necessary to sink a new shaft, which should, I think, be located in line with the copper ore ground, opposite the old main shaft, as shown in plan.

"The size of this shaft should be 12ft. by 5ft., to be divided into four compartments—two for hauling, and one each for pump and ladder way. The cost would

be about £25 per fathom, timbering included.

"This shaft should be sunk to cut the main lode at the 60-fathom level. A cross-cut should be driven from the present 30-fathom level to it as well as from any lower levels to facilitate ventilation.

"Ore produced—From the small amount of ore ground developed in this mine, there was shipped as follows:—

Copper Ore, 2639 tons, value £41,079, £15 11s. per ton.

Lead ore, 2968 tons, value £30,459, £10 5s. per ton.

"Ore Values.—In my statements of the produce of different places in the mine, I have made use of the term 'tons per fathom,' and by this I mean ton of concentrated ore per fathom of ground, and not as found in the lode where it is mixed with quartz, etc.

"With regard to these values, the copper ore after dressing averaged from 17 to 18 per cent, and the lead ore from 75 to 80 per cent., with from 4 to 6 ounces silver, and 2 to 3 grains of gold per ton.

"General.—At the period when operations ceased at the mine, the conditions under which work was carried on were naturally much different to present-day conditions. The company had started work then with an entirely inadequate working capital, with the result that within a comparatively short time from its inception, and moreover before the mine could be thoroughly developed, the capital had all gone. The produce of the mine was therefore mortgaged ere it had actually been brought to surface, in order that the work might be kept going on. Consequently the result of such a condition of matters ultimately led to my advising closing down unless additional working capital could be raised. An attempt to do this was made, but in these days mining companies' shares had not the same attraction as is now the case, and the endeavour was unsuccessful.

"The following comparisons may be well worth mentioning with regard to former and present-day conditions:—

"Transport.—The transport charges—there being then no railway—from the mine to Geraldton were £2 per ton, latterly reduced to 30s. per ton. Now the charge is 6s. 8d. per ton, being 3s. from the mines to Northampton Station, and 3s. 8d. from there by rail to Geraldton. There is thus a saving in your favor of 23s. 4d. per ton on my lowest figure.

"Dressing Machinery.—The appliances for dressing ores have advanced in efficiency, and a much cleaner product is now obtainable at reduced cost. I should say that the cost of working a modern concentration plant has decreased about 50 per cent.

"Freights.—These were difficult to obtain, and shipments of ore in many cases took twelve months ere delivery was made in England. Now there is a regular service of steamers to this country.

"Conclusions.—Owing to the limited working capital I was prevented from pursuing the vigorous prospecting and developing policy this highly mineralised area deserved, and the result was that, although numerous other deposits of mineral were known to exist on the properties, I found it futile to attempt to prove their extent and value. Thus, of the entire acreage, not more than perhaps 5 per cent has as yet been explored by the underground working, and this 5 per cent. only to a depth of 250 feet.

"From the knowledge I have of the mine, I am thoroughly satisfied from the character of the lodes that they will be permanent and productive in depth; and I am of the opinion that should the property be again taken up and thoroughly developed in a vigorous manner, and under good management, having an adequate working capital, there is every prospect of its becoming a successful mining concern."

(Signed) JAMES PENBERTHY.
(Late Manager.)

The whole of the papers were then placed in the hands of Mr. Alexander Benson, M.A.I.M.E., together with Captain Penberthy's report, and he was asked as an expert carefully to go through and report on them. The following is the essential portion of his report, together with a synopsis of the Tut Work Sheets as prepared by him:—

"Broad-st. House, Old Broad-st.,
London, E.C.
21st June, 1900.

"I submit my report upon the workings of the Fortune Lead and Copper Mines of Northampton, Western Australia, compiled from authentic papers submitted to me, and, particularly, so far as regards its past results, from the working sheets, plans, correspondence, etc., sent by the then manager, Mr. James Penberty, to the directors of the company in London.

"Short History of the Locality.—Opened up in the early forties, the raisings and export of ores until the end of the year 1896 amounted to:—

Copper ore, 10,232 tons, value £161,320.
Lead ore, 33,939 tons, value £370,154.

"So far as can be ascertained, although these exports were spread over an extend-

ed period of years, yet practically the whole of this output was sent out prior to the opening of the Government railway from Northampton to Geraldton in 1879. Before that date, however, the goldfields of Victoria had been discovered, being immediately followed by the inevitable rush of miners from all parts of the world, and copper and lead mining around Northampton was to all intents and purposes abandoned, and most of the old workings allowed to fill with water.

"In view of the fact, however, that little foreign capital was ever invested in this district, and that in these early days raisings must necessarily have been retarded by inadequate means for economic production and subsequent realisation, and when it is taken into consideration that in no case had exploration exceeded a depth of 300 feet, the production must be considered extremely good.

"Output of Ore.—Taking the figures from the first opening of the Fortune Mines by the original owners until the date of closing down by the company in August or thereabouts of 1867, the original papers show the export of ores to and realised value in England to be as follows:—

Copper ore, 2376 tons, realising £37,009 10s. 4d.

Lead ore, 2732 tons, realising £28,039 15s. 10d.

to which should be added a cargo lost by the sinking of the ship 'African' of

Copper ore, 263 tons, value (estimated), £4070.

Lead ore, 236 tons, value (estimated) £2420.

The total output, therefore seems to have amounted to 5607 tons of copper and lead ores, of the value of £71,539 6s. 2d.

"Ore Percentages.—I have had submitted to me a number of original account sales, various assay and other certificates —of Messrs. French and Smith, E. L. Budd, and Co., etc., of London, to whom the ores were sold—and taking the mean, it appears that the respective ores shipped contained on the average:—

Copper ore, 17 per cent. copper.

Lead ore, 75 per cent. lead.

"The lowest value for copper contents appears to have been that of a small shipment containing only 15⅝ per cent., but against this there appears a shipment which went for copper as high as 35½ per cent. One assay certificate also states that:—

'The sample contains a large quantity of lead, and is very troublesome in the assay furnace. The quality of the copper is very good.'

From which I would infer that considerable quantities of lead may have been unaccounted for in this way, viz.—being present in the copper ore, and probably vice versa.

"Transit and Other Costs.—Taking the mean of 19 shipments, the cost for freight, charges, etc., from Geraldton to England amounted to 52s. per ton; the cartage from the mines to Geraldton averaged 40s. per ton; and the insurance of the ores, including charges on them in England (taking the mean of figures on 1200 tons) amounted to 7s. 6d. per ton.

"The total cost, therefore, on ores dressed on the mines until realised in England (but exclusive of costs of bags, agent's commission and storage in Geraldton) amounted to £4 19s. 6d. per ton; and taking the date from which the ores were sent off the mines until their arrival in England a period must have elapsed on the average of fully nine months.

"It is hardly necessary for me to point out that the foregoing figures are capable of being greatly reduced now—for instance, carriage from mines to Geraldton should not now cost more than from 8s. to 9s. per ton.

"Mining and Ore Dressing.—An inventory of the machinery, etc., formerly on the mines has been submitted to me. Apparently power for all purposes was supplied by one 20ft. by 4ft. 6in. tubular table engine; at the most northerly shaft on the Fortune workings winding appears to have been done by means of a horse whim.

"The ore dressing appliances seem to have consisted of three jigging machines, 4ft. 4in. by 2ft. 2in. by 4ft. 6in. deep, and five other hand jiggers. buddle, etc. These treated the ore crushed by a 16in. stonebreaker.

"The figures given below may be of interest as indicating the small tonnages extracted by miners in these early days—no doubt owing in the main to the want of labour-saving appliances, such as rock drills, etc. The figures also serve to demonstrate that dressing costs must have run exceedingly high, owing to the heavy proportion of labour employed on the ore floors as compared with the other labour employed, also with the actual number of miners working on the mines.

"The following are figures for the period from January, 1866, until August, 1867:—

Average Monthly Labour Employed.	
Developing	17
Stoping...	13
Dressing	12
Surface	14
Total employed monthly ...	56

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"Width and Value of Lodes.—Dealing with the ground exploited by the main workings, appended is a synopsis of the Tutwork Setting Sheets as to width and ore value of the lodes at the various workings in the mines. The points of operations marked thus (*) were being worked at date of closing down.

"I would remark that it is unique in the history of most mining concerns which open up after a lapse of many years for original working papers to be available, and if they are reliable (which there is every reason to believe), I have no doubt whatever that the operations of a moderately capitalised company—given, of course, an efficient management—will meet with success.

(Signed) ALEX. BENSON, M.A.I.M.E.

SYNOPSIS OF TUT WORK SHEETS.

Points of Operations.	Period Worked	Average width and value of Lode during period worked, assuming Copper Ore of 17 % and Lead Ore of 75 % to be worth respectively £13 and £11 per ton of ore.	
		Width.	Value per Fathom.
	MTHS.	FEET.	£ s. d.
MAIN SHAFT WORKINGS.—			
48 FOOT LEVEL.			
N.-E. of Shaft—			
Driving	6	1¾	9 15 0
No. 1 Stopes, back	3	1⅛	13 0 0
S.-W. of Shaft—			
No. 1 Stopes, back	2	2	16 10 0
180 FOOT LEVEL.			
N.-E. of Shaft—			
Driving	14	3	19 5 0
No. 1 Stopes	3	2¾	27 10 0
No. 2 Stopes, back	7	2½	22 0 0
No. 2 Stopes, bottom	1	3	16 10 0
S.-W. of Shaft—			
Stopes, S.-W. lode	3	1¾	22 0 0
No. 1 Stopes, back	12	2⅛	32 5 0
No. 2 Stopes, back	6	2¾	30 5 0
No. 1 Stopes, bottom	15	2	30 2 6
No. 2 Stopes, bottom	1	2	16 10 0
S.-E. Lode—			
No. 1 Stopes, back	3	2	38 13 0
No. 2 Stopes, back	5	2¼	35 0 0
Winze, bottom	3	1½	16 10 0
240 FOOT LEVEL.			
S.-W. of Shaft—			
No. 2 Winze	3	2¼	26 0 0
Underlay Shaft—			
S.-W. Stopes, bottom	2	2¾	29 5 0
300 FOOT LEVEL.			
N.-E. of Shaft—			
End	21	3	19 7 6
No. 1 Stopes, back	10	1¼	17 17 6
No. 2 Stopes, back	2	1½	15 5 0
S.-W. of Shaft—			
End	11	2	3 5 0
Stopes	5	2¼	7 17 6

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SYNOPSIS OF TUT WORK SHEETS.

Points of Operations.	Period Worked	Average width and value of Lode during period worked, assuming Copper Ore of 17 % and Lead Ore of 75 % to be worth respectively £13 and £11 per ton of ore.	
		Width.	Value per Fathom.
	Months	feet.	£ s d.
WHIM SHAFT WORKINGS—			
Shaft—			
Sinking	9	1¾	8 5 0
72 Foot Level			
S.-W. of Shaft—			
Driving	7	2½	28 10 0
No. 1 Stopes, back ...	9	3¼	35 13 0
No. 2 Stopes, back ..	5	1¾	23 0 0
N.-E. of Shaft—			
... ...	2	1¾	—
120 Foot Level			
S.-W. of Shaft—			
Driving	6	2¼	16 15 0
No. 1 Stopes, back ...	10	2¼	26 15 0
*No. 2 Stopes, back ...	11	3¼	33 0 0
180 Foot Level.			
N.-E. of Shaft—			
Driving	9	3¾	8 5 0
S.-W. of Shaft—			
*No. 1 Stopes, back	16	2¼	27 10 0
*No. 2 Stopes, back ..	16	3	32 2 6
*No. 3 Stopes, back ...	9	2½	23 7 6
240 Foot Level.			
S.-W. of Shaft—			
*No 1 Stopes, back ...	8	4¾	30 5 0
*No. 2 Stopes. back ...	7	6	37 2 6
*No. 3 Stopes, back ...	3	2	23 7 6
No. 4 Stopes, back ...	2	2	12 7 6
Winzes.			
S.W. of Shaft—			
Surface	4	1½	17 6 8
72 Foot Level	3	2	26 5 0
120 Foot Level	2	3	22 0 0
180 Foot Level	4	5	27 10 0
180 Foot Level, No. 2 ...	3	2½	15 2 6
240 Foot Level	2	3	—

*NOTE.—Points of operations marked thus (*) were being worked on an average for the eight months immediately preceding closing down.

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APPENDIX III.

THE GWALLA.

"Gwalla Mine—Since the publication in the daily newspapers of my remarks on this mine, based on the information given to me on the spot by the manager, Mr. Oxley, Mr. J. K. Weir, of Perth, who states that he is the holder of an option over the property, has forwarded to me certified copies of reports on the mine made by Mr. Oxley and Mr. G. H. Williams, which are of a very favorable character, quite opposite to the pessimistic account verbally given to me by the former. In justice to the owners of the property, I now attach the principal portion of these reports:—

"Mr. Oxley says:—'I reached Northam on Feb. 8th, 1907, to pump out and examine the above mine, completing my work on Aug. 16th of the same year. 'I centred my work on the hill south-west of railway station, on the most southerly lode, where three shafts had been sunk to a depth of 180 feet, with three levels, viz., 10, 18, and 30 fathoms. The 10-fathom level had fallen in, so I made no examination of it. The 18-fathom level ran from D shaft 463ft. south-west, and 90ft. north-east. The whole of the backs of this level had been stoped, but virgin ground underneath. I found high-grade ore the whole length, from which I took seven samples, the assay values of which were—No. 1, copper, 28.59; No. 2, copper 41.07; No. 3, copper 26.01; No. 4, copper 29.03; No. 5, copper 30.59; No. 6. copper 27.01; No. 7 copper24.63. These do not represent the true values of the whole width of the lode, which averages from 4ft. to 20ft., but are taken from extreme ends and at regular intervals between. The best ore has evidently been removed, but I estimate the ore in sight from places where samples were taken would go from 2 to 4 tons per fathom. The 30-fathom level in the main shaft (D) has only been driven 50ft. south-west and 30ft. north-east on the lode, which averages from 4 to 12ft. wide. The backs have been stoped for 20ft. north and south on the hanging-wall; in the remaining portion of the backs and face in south drive there appears a strong make of bornite ore, about 9in. wide, running the whole length, with small seams of black oxide occurring right across to the footwall. In the north drive a good make of bornite ore appears, 14in. wide, with smaller seams showing across the lode. I did not see the true face at this end, as there has evidently been a pocket taken out further on, which was filled with debris. I estimate the value of the ore left to go from 2 to 6 tons per fathom, but the richest ore has been removed, and from the unfinished appearance of the work there can be no doubt the previous workers were flooded out. The lode is more settled and the make of ore stronger at this depth than in any other part of the mine, and I am convinced this is a true fissure lode, and will continue to great depth; the walls here are vertical and well defined. I am of opinion that very rich ore would be got if this level was continued north and south. Five hundred and ninety-four feet north-east on same line of lode I sank a shaft 10ft. deep and drove north and south respectively 20ft. and 21ft. 6in. At 87ft. I struck a good make of bornite ore, a sample of which assayed 33.85 per cent. The ore continued to depth of shaft, and was improving. I commenced driving at 98ft., and was on good payable ore the whole length. At 10ft. I had a wet assay taken from the whole width of each face by the local manager for the Fremantle Smelters, Ltd., who returned them at 12 per cent. When finishing my work the lode was 7ft. wide, quite vertical, and I estimate the ore in sight would go from 2 to 4 tons per fathom. If this shaft was carried down to 180ft., and drive completed to D shaft (south) I am convinced that ore richer than has previously been found in the mine would be taken out. I tested this line of lode at 100ft. depth for 1,078 ft., and found high-grade ore the whole length. The other two parallel lodes north occur on each side of a strong bar of diorite, to which they have a slight underlay. They are strong, well-defined lodes. principally quartz schist, and from appearance should say that at a depth made into one lode carrying good ore. These have been worked by several shafts up to 70ft. deep, and quantities of ore taken from them, samples of which can be seen on the dumps. The ores generally consist of bornite, black oxide, grey, and chalcopyrite. I pumped the mine out with a Worthington pump, capable of throwing 7,000 gallons per hour, driven by a 12 h.p, vertical boiler, but at no time worked it at more than 5,000 in one of the wettest seasons ever known in the district. The mine had then been flooded for upwards of forty years, and had 60ft. of debris at bottom of shaft to be cleaned out. The water level is 36ft. I consider with a strong working capital this should become a very valuable property. It will take years to work it out, and, being alongside

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the Northampton railway station, with unlimited supplies of wood and water, and 34 miles from the finest harbor on the the west coast of Australia, copper should be produced at a lower rate per ton than by any other mine in this country."

Mr. Williams says: "The chief workings are done on the east lode. There are several shafts on this lode, the deepest of which is 180ft. The strike of the lode is N.E. by S.W., and the dip is practically vertical.

"Mill Shaft.—This shaft is sunk to a depth of 100ft., and is connected with the lode by means of a short crosscut at the 100ft. level.

"South Level.—This level is driven south from the crosscut for a distance of 100ft. There has been a considerable amount of stoping done on the back of this level. I was not able to obtain any samples from the bottom of the level, as there was about a foot of water on the bottom of this level. This was caused by the late heavy rains, but it appears to be all virgin ground on the bottom of this level.

"At about 15ft. from the present face there is a jump-up about 10ft., and the level is driven south a further distance of 40ft. There is a good vein of bornite and black oxide of copper showing in the back of this level, and also on the bottom of the level. The lode in the present face is about 3ft. wide, and is composed of quartz schist, and with veins of black oxide. I estimate the value of the ore in sight in this level at about 3 tons of 40 per cent. ore per fathom.

"North Level.—This level is driven north from the crosscut 300ft to connect with the main shaft. There has been a considerable amount of stoping on the back of this level, and a little underhand stoping done also. I was only able to get samples in two places in the bottom of this level, as there was about a foot deep of water in most places. I got samples of very good ore, bornite and black oxide, in both places that I sampled, and I have no doubt there would be good blocks of ground along the bottom of this level that would pay well, if the water was let down.

"Main Shaft.—This shaft is sunk to a depth of 180ft. There is a level at the 100ft. drive south to connect with the Mill shaft. There has been a considerable amount of stoping done on both ends of the shaft right down to the bottom 180ft. level.

"180-Ft. Level South.—This level is driven south about 50ft. on a lode formation from 4 to 10ft. wide. The back of the level has been stoped for about 20ft. south from the shaft. On the end of the stope and along the back of the level there is a good make of ore, bornite and black oxide, which I estimate will yield from 3 to 4 tons of 40 per cent. ore per fathom. In this place, also, I was unable to see the bottom of the level, on account of there being a lot of mullock and some water in the bottom of the level.

"180-Ft. Level North.—This level is driven a considerable distance north of the shaft, but I was not able to get right into the face on account of the accumulation of debris and water. The back of the level has been stoped for about 30ft. north of the shaft. The lode in the end of this stope is about 3ft. wide and carries some good ore. I estimate that it is worth about 2 tons of 40 per cent. ore per fathom. The lode appears to open out further ahead in the level, but I could not get in to see what it was worth for copper.

"I regret that I could not get samples from the bottom of the level, more especially from beneath the stopes, because it appears to me that the former manager only took out or stoped the richest parts of the lode, and as this make of ore was over 60ft. long, and judging by the width of the stopes it must have been from 5 to 7ft. wide. The make of the ore must still continue downwards, and, as this is the bottom of the mine, beneath this level must be virgin ground.

"E. Shaft.—This shaft is situated on the same line of lode, about 800ft. N.E. from the main shaft. It is sunk to a depth of 104ft. on the course of the lode, and is practically vertical. The lode is from 4 to 6ft. wide. In the ends of the shaft it is composed of quartz schist and porphyry, carrying small veins of chalcopyrite, bornite, and black oxide of copper.

"98-Ft. Level North.—This level is driven 20ft. north on the lode. The lode is about 7ft. wide, and is composed of quartz schist and porphyry, and carries small veins of black oxide and chalcopyrite. It should yield about 2 tons of 30 per cent. ore per fathom by concentrations. The present face is of slightly lower grade.

"98-Ft. Level South.—This level has been driven south on the course of the lode for a distance of 21ft. 6in. The lode matrix is the same as the north level, but carries better ore, bornite and black oxide of copper; the lode is improving going south. I estimate the present value at about 3 tons of 40 per cent. ore per fathom. The width of the lode is 8ft. There is another shaft about 1000ft. north-east of E. shaft on the same line of

lode. It has been sunk to a depth of 70ft., and a considerable amount of work done. I could not get down, as the water was within 30ft. of the surface, but I got some good specimens of bornite and green carbonates on the dump.

"Middle Lode.—This lode is about 700 ft. west of the east lode, and runs parallel with it. The lode has been opened out at several different places by means of small shafts, and it carries copper ore for the whole length that it has been tested. At the south end, near the boundary of the property, there are three shafts supposed to be about 70ft. deep, but, as the water comes to within 30ft. of the surface, I could not get down the shafts; the lode appears to be about 4ft. wide, and carries very good walls to the water level; it is almost vertical. I got some good specimens of bornite and blue and green carbonates on the dump, and, judging by the stuff on the ore floors, there must have been a good quantity of ore taken out from this place.

"West Lode.—This lode is almost 100ft. west of the middle lode. It has been proved to a considerable depth by means of two shafts. There are specimens of blue and green carbonates on the surface.

"In conclusion I may say that I consider that this is one of the most valuable copper properties that I have seen in a long experience of copper mining in South Australia and Queensland. The lodes are all true fissure veins, with well-defined walls, and give promise of living to a great depth, and they appear to be improving in depth. If this property is equipped with good pumping plant and good ore-dressing machinery, I have no doubt that it will prove to be a highly payable proposition. The mine being situated close to the railway station, the cost of sending the ore away will be very light, and as there is plenty of good water suitable for use in boilers and for ore concentration, and plenty of timber for fuel and mining purposes in the district close to the mine, the cost of mining should be low."

It is to be remembered that at the time of my visit the mine was inaccessible on account of the water having been allowed to rise, and that I was necessarily obliged to depend on such information as could be got, for what it might be worth. The unfavorable account given to me verbally by Mr. Oxley was supported by collateral indications on the ground, such as the small amount of ore of even very low grade that was to be seen on the dumps, the absence of specimen lumps of good ore in the mine office—though there were plenty of pieces of poor ore—and the obviously low grade of the parcel of bagged ore ready for shipment, which was exhibited to me by Mr. Oxley. The ore on the dump round the eastern shaft was the most promising of any I saw, and it was poor silicious concentrating material. I saw no bornite, though there were occasional pieces of tarnished chalcopyrite resembling it, and only occasionally sooty coatings of black ore of little quantitative consequence. There was nothing to make one think it probable that good ore had been obtained. Such appearances are, however, I fully admit, by no means sufficient to found a judgment upon, and I have no reason to gainsay the reports, which have therefore been fully quoted. For a mine alleged to contain the quantities of 40 per cent. ore shown in Mr. Williams' report, I would nevertheless remark that there was marvellously little trace of any such having been lately raised visible on the surface round the various shafts.

A. MONTGOMERY, M.A., F.G.S.

State Mining Engineer.

21st May, 1908.

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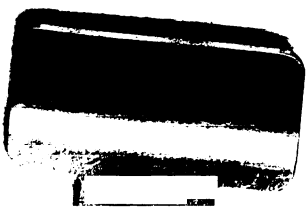

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